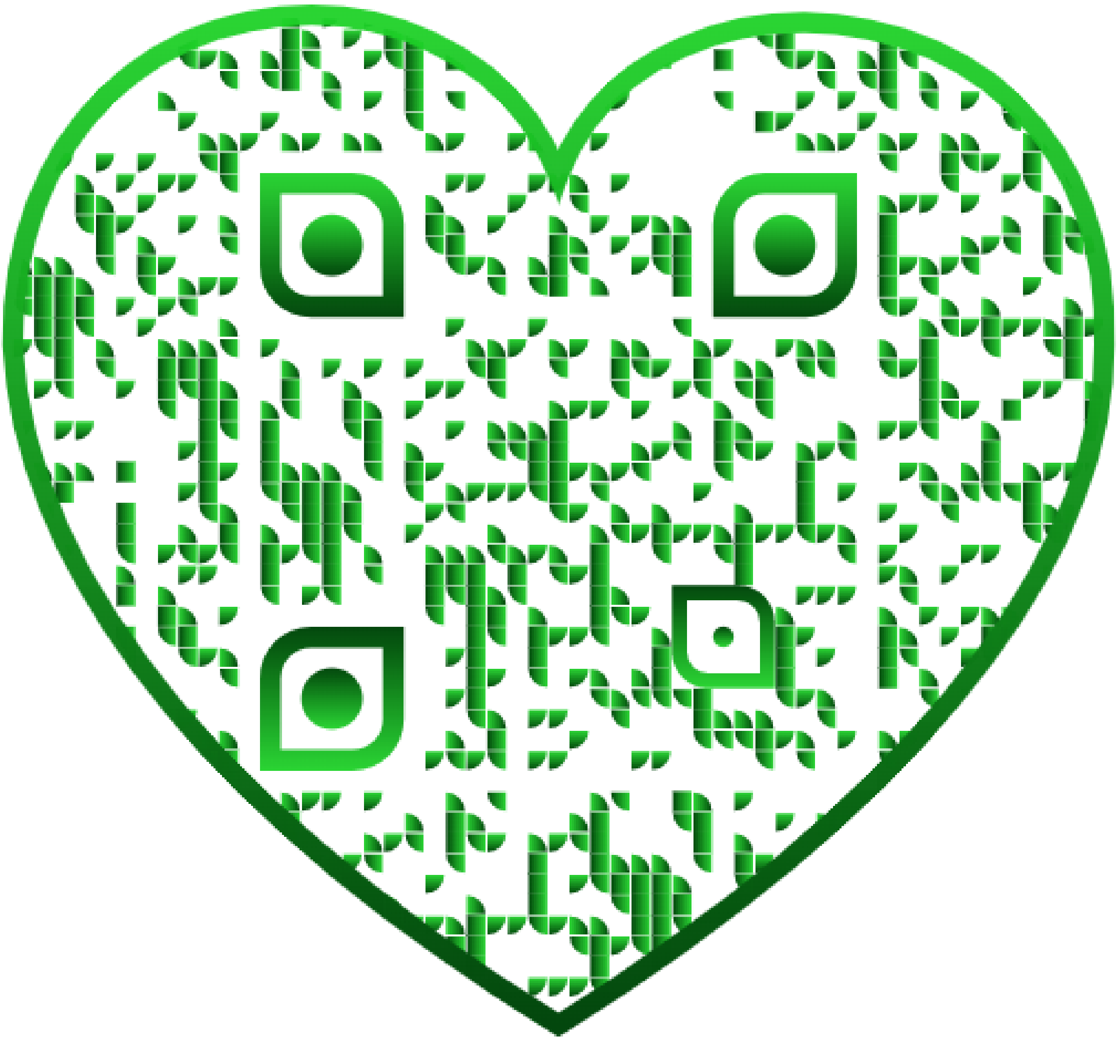
Clinical Methods
in Ophthalmology



Clinical Methods in Ophthalmology

Practical Manual for Undergraduates

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Dedicated to

My parents
Mr Karimsab B and Mrs Babujan K
for their blessings
My uncle
Mr Emamsab B
for his encouragement
and
My wife
Dr Shama
for her support

FOREWORD

I have a great pleasure in writing the foreword of *Clinical Methods in Ophthalmology: Practical Manual for Undergraduates* meant for the undergraduate and postgraduate students. My pleasure is multiplied by the fact that Dr Dadapeer has been working with me for several years at Hassan Institute of Medical Sciences, Hassan, Karnataka, India. He has a keen interest in the teaching of medical students. He has ability in gauging the pulse of the students and also their needs and requirements.

Only few other branches of Medicine have seen such dramatic changes in the last decade as Ophthalmology. Even though tremendous strides have been made in the practice of this specialty, a sense of proportion has to be assigned to the subject. Stress should be on the basics and common day-to-day problems, so that newer ophthalmologists can deliver good services to the patients.

In this era of information explosion, a student has to study a lot of materials. At present, most of the books are either too voluminous in the guise of being comprehensive with material not easily assimilated by the students or they are too simplistic in their contents and approach, which fail to impart sufficient knowledge and confidence among the students. I hope that this book by Dr Dadapeer K will serve to fill up this lacuna in the undergraduate teaching material.

He has discussed many topics in this book with a clinical orientation. He has not only made it a comprehensive text on the subject, but also topics important from examination and practical stand point are dealt with in precise and piecemeal fashion. The contents are carefully crafted to meet the undergraduate curriculum. Important points are highlighted and are supported by an array of neat photographs and depictive illustrations. Emphasis has been on Ophthalmic Examination Methods, Case Proforma and Diagnostic Tools. Ophthalmic lenses have been elaborately outlined. The drugs used in Ophthalmology have been aptly described. The chapter 'An Approach to a Patient with Red Eye' is an attractive feature of the book. This will make the book useful for general practitioners as well.

The hallmarks of the book are its simple understandable language, lucid description of facts and emphasis on practical diagnosis and management.

I wish all the success to this utility oriented book, which will definitely prove to be a boon for students and practitioners.

Ravikumar BC
Professor and Head
Department of Dermatology
Former Director
Hassan Institute of Medical Sciences
Hassan, Karnataka, India

FOREWORD

There is no alternative to a proper history taking and thorough clinical examination.

I am very much pleased to have the opportunity to write the foreword of this book. The ultimate goal of a medical student should be to become a good clinician by the end of his undergraduate studies. This book is unique and gives the students a comprehensive concept of clinical methodology and helps them to acquire complete knowledge about the subject. Dr Dadapeer K takes the student through a journey in a clear and concise method with multiple illustrations and thoughtful explanations towards the achievement of acquiring high-quality clinic acumen.

He was a very good enthusiastic student during his undergraduate and postgraduate days and showed keen interest in learning, sharing the knowledge with his fellow students and teaching the junior students.

The book is a complete clinical manual for the undergraduate medical students by covering both the theoretical details and clinical aspects supported by conceptual illustrations, which help in better understanding of the clinical methodology. He has taken tremendous effort to present a systematic approach to the clinical aspects of disease process.

The book will be an adjunct to the many other textbooks for the postgraduate medical students and provides an excellent source of learning and reference.

I hope that this book will be a valuable addition to the library of any establishment involved in the teaching of the medical students and thereby helps in substantial contribution to the health care system by providing a good clinician to the society and mankind.

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PREFACE

This book is basically written for the needs of undergraduate medical students. I have observed that the undergraduate medical students often find it difficult to understand Clinical Ophthalmology in spite of knowing theory part of it. The book aims to present Clinical Ophthalmology in a simplified, yet in a comprehensive manner with a lot of clinical photographs. Few chapters are discussed in more detail to provide complete information of the topic and this will be beneficial to the postgraduate students and residents in Ophthalmology also. The book has the following key features thus making it, an easy-to-use guide for the students:

- History taking with clinically structured questionnaire for each case.
- Detailed case discussion with explanation of clinical problems.
- Comprehensive coverage with emphasis on clinical application.

While writing this book, I have gone through many books, enquired students regarding their common doubts and problems, recollected what my teachers had taught me and then I have presented all of them in a concise manner. I hope that the book will be a useful guide for the medical students during their course in Ophthalmology. Efforts have been made to check for the accuracy of the matter and to correct the mistakes, if any. I will be happy to receive constructive comments, which will help in betterment of the book.

Dadapeer K

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My whole-hearted expression of gratitude to one and all who have contributed in many ways for completion of this book.

I would like to extend my heartful thank to colleagues of the Department (Ophthalmology), i.e. Dr Kavitha CV, Dr Balasubramanya S, Dr Pavana Acharya, Dr Nataraj PL, Dr Shivaprasad, Mr Prakash, Mr Kumar, Mr Radhakrishna, Mr Nagesh, Mr Shivaraj, Mrs Renuka, Mr Narayana and House Surgeons of Hassan Institute of Medical Sciences, Hassan, Karnataka, India, for their help rendered to me. I am grateful to the positive feedback and encouragement by Dr Niranjan MR, Dr Praveen G, Dr Guruprasad, Dr Pratap and Dr Suresh RM. I would like to thank Dr Gangadhar (Former Director) and Dr Premkumar (Former Medical Superintendent), Hassan Institute of Medical Sciences, India, and my good friends Dr Ramesh, Dr Devraj R, Dr Pradeep, Dr Gayathri and Dr Krishna Sagar, for their support. I am thankful to my teacher Dr Jyothi Swarup, Professor of ENT, Sri Siddhartha Medical College, Tumkur, Karnataka, India, and my postgraduate teachers at Bangalore Medical College, Bengaluru, Karnataka, India, viz. Professors Raviprakash D, Ramesh TK, Sriprakash KS, Prabha AR, Shivaprasad Reddy, Surendra and Shivakumar, for being an endless source of inspiration.

I affectionately thank my friends and relatives for their constant support and encouragement. I am also thankful to my students for inspiring me during writing of the book. Dr Shrimanth, Dr Madhusudan, Dr Chandan BC, Dr Sharan, Dr Abdul Qadeer, Dr Shashidhara, Dr Fahima Shakir, Dr Samarath, Dr Shobhitha, Dr Girish, Dr Prakash, and Interns, Hassan Institute of Medical Sciences, India. Dr Kavitha Senthil, Consultant, Vasan Eye Hospital, Bengaluru, Karnataka, India and Dr Parivadhini AP, Consultant, Sankara Netralaya, Chennai, Tamil Nadu, India, require special thanks for putting their sincere efforts to correct the mistakes. I am thankful to Dr Ravikumar BC, Former Director and Professor of Dermatology, Hassan Institute of Medical Sciences, India and Dr Jyothi Swarup, Professor of ENT, Sri Siddhartha Medical College, India, for writing foreword to the book.

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CHAPTER

1

SYMPTOMATOLOGY IN OPHTHALMOLOGY

CHAPTER OUTLINE

- Symptoms Related to Vision
- Symptoms Not Related to Vision
- Symptoms due to Adnexa of The Eye
- Vision Related Complaints
- Complaints Not Related to Vision

The symptoms for which patients visit ophthalmology department can be divided into symptoms of eye related to vision, symptoms of eye not related to vision and symptoms due to adnexa of the eye.

SYMPTOMS RELATED TO VISION

- Defective vision including blurring of vision and diminution of vision
- Loss of vision
- Transient loss of vision
- Floaters
- Flashes of light
- Glare
- Photophobia
- Distorted vision
- Diplopia
- Colored halos
- Day blindness
- Night blindness
- Diminution of vision for near only.

SYMPTOMS NOT RELATED TO VISION

- Redness
- Watering
- Discharge
- Itching
- Pain
- Headache
- Deviation of the eye
- Protrusion of the eye.

SYMPTOMS DUE TO ADNEXA OF THE EYE

- Drooping of the upper eyelid—ptosis
- Retraction of the eyelids
- Inward or outward turning of the lid margin—entropion or ectropion
- Increased blinking rate of eyelids—blepharospasm
- Inability to close eyelids—lagophthalmos
- Inward misdirection of eyelashes—trichiasis
- Swelling in the lacrimal sac region
- Watering and discharge.

VISION RELATED COMPLAINTS

Blurring of Vision

It refers to hazy vision or foggy vision where the details of objects cannot be made out, i.e. decrease in quality of vision without decrease in quantity of vision. Causes of blurring of vision are:

- Early cataract
- Minimal amount of astigmatism
- Nebular grade corneal opacity.

Diminution of Vision

It refers to decrease in vision which can be measured by snellen's visual acuity chart, i.e. decrease in quantity of vision. Diminution of vision can be painful or painless, sudden or gradual in onset.

Causes of Gradual Painless Diminution of Vision

- *Conjunctiva:* Progressive pterygium encroaching pupillary area
- *Cornea:* Corneal degenerations and corneal dystrophies
- *Lens:* Cataract
- *Retina:*
  - – Macular degenerations and macular dystrophies
  - – Diabetic retinopathy and other retinopathies
  - – Chorioretinal degenerations and dystrophies
- Primary open angle glaucoma
- Refractive errors.

  Optic nerve: Hereditary optic atrophies, drug induced optic neuropathies and toxic amblyopia.

Causes of Gradual Painful Diminution of Vision

- Corneal ulcer
- Chronic iridocyclitis.

Causes of Sudden Painless Diminution of Vision

- Vascular occlusions of retinal vessels like central retinal artery occlusion, central retinal artery occlusion, ciliretinal artery occlusion, branch retinal artery occlusion and branch retinal vein occlusion central retinal vein occlusion
- Optic neuritis, nonarteritic anterior ischemic optic neuropathy
- Central serous retinopathy
- Vitreous hemorrhage
- Retinal detachment.

Causes of Sudden Painful Diminution of Vision

- Mechanical or chemical trauma to eye
- Acute iridocyclitis
- Acute angle closure glaucoma
  Gaint cell arteritic with arteritic ischemic optic neuropathy.

Loss of Vision

Loss of vision refers to inability to perceive light, i.e. PL (perception of light)—NEGATIVE.

Causes for loss of vision

Only disease involving retina and or optic nerve can cause total loss of vision.

Isolated diseases of lens or cornea can never cause PL negative vision unless there is a problem in retina and or in optic nerve like optic atrophy, total retinal detachment….

Transient Loss of Vision

It is also called amaurosis fugax. It is characterized by sudden, temporary loss of vision due to transient hypoxia of visual system. The attack losts from few seconds to 30 minutes and it recovers completely.

Causes

- Migraine headache aura
- Transient ischemic attack involving visual cortex
- Papilledema
- Prodromal symptom of central retinal artery occlusion, anterior ischemic optic neuropathy
- Hypoperfusion which may be due to hypotension, cardiac failure, anemia, etc.
- Carotid artery disease and atherosclerotic cerebrovascular disease.

Floaters

A condition in which patient perceives black spots in front of the eyes which move with the movement of eyes.

Any opacity behind the nodal point of the eye, i.e. behind the lens will cast its shadow on the retina causing floaters.

Causes

- Posterior vitreous detachment
- Vitreous hemorrhage
- Vitreous opacities like muscae volitantes, asteroid hyalosis, synchysis scintillans...

Flashes of Light

A condition in which patient perceives a sensation of flickering of lights. It is also called photopsia. This occurs because of traction on the retina vitreoretinal attachments, irritating the retina and causing it to discharge electrical impulses which are interpreted by brain as flashes of light.

Causes

- Posterior vitreous detachment
- Retinal tear
- Prodromal symptom of retinal detachment.

Glare

A condition in which patient has difficulty to see in bright light.

Causes

Because of diffraction of light caused by opacities in the refractive surfaces like corneal opacity or lens opacity, i.e. cataract.

> Normally every one would have experienced glare while driving during night or on seeing sun directly.

Photophobia

A condition in which patient has difficulty to see/to open eyes in normal intensity light.

Because of stimulation of sensory nerve endings in corneal affections like corneal epithelial defect, corneal ulcer, keratitis, corneal edema….. and in acute iridocyclitis.

Distorted Vision

A condition in which the patient perceives objects to have altered size or shape.

- *Micropsia:* Objects are perceived smaller in size
- *Macropsia:* Objects are perceived bigger in size
- Metamorphopsia: Objects are perceived altered in shape.

Causes

Macular lesions like macular edema, macular degeneration...

Diplopia

A condition in which the patient perceives double images of an object.

Binocular Diplopia

Diplopia is present only when both eyes are open and it disappears on closing one eye.

Problem with nerve, nerve muscle junction or muscle can lead to binocular diplopia.

- Paresis or paralysis of nerves supplying extraocular muscles—paralytic squint
- Myasthenia gravis
- Fractures of orbit with entrapment of extraocular muscles
- Thyroid disorders affecting extraocular muscles.

Uniocular Diplopia

Diplopia is present even with one eye (abnormal eye) being open. Problem within the refractive medium of the eye involving cornea or pupil or lens can cause uniocular diplopia because of double refraction.

- Corneal causes like keratoconus
- Causes in pupil like double pupil subluxated lens
- Causes in lens like subluxated lens, displaced intraocular lens, incipient cataract.

Colored Halos

A condition in which patient perceives colored rings around lights.

Colored halos are because of prismatic dispersion of light (breakage of light into seven colors because of abnormal collection of fluid) in the refractive media, i.e. in cornea and or lens.

Causes

- Collection of mucus on corneal surface as in conjunctivitis
- Corneal edema because of bullous keratopathy or acute congestive glaucoma
- Immature cataract.

> The causes can be differentiated from another by the following methods:
>
> Colored halos due to collection of mucus on corneal surface as in conjunctivitis will disappear if the mucus is removed manually or by eye wash.
>
> Colored halos due to corneal edema and immature cataract can be differentiated by Fincham stenopaeic slit test.

Fincham stenopaeic slit test:

A stenopaeic slit 2 mm wide is passed infront of the eyes, the colored halos because of corneal edema remain intact and the colored halos because of lenticular opacity are broken into segments.

The appearance of colored halos can be demonstrated by asking the patients to look through lycopodium powder enclosed between two glass plates.

Day Blindness

Day blindness is called Hemeralopia. It is a condition in which patient has decreased vision in day light/bright light.

Causes

- Diseases of cones like congenital deficiency of cones
- Central opacities in the cornea and or in lens like central corneal opacity and polar cataracts (as the pupil constricts in bright light the opacity in the center will come in the path of light causing diminution of vision).

Night Blindness

Night blindness is called nyctalopia. It is a condition in which patient has decreased vision in dim light/night.

Causes

- Diseases of rods like retinitis pigmentosa
- Vitamin A deficiency
- Congenital stationary night blindness, Oguchi's disease and fundus albipunctatus
- Pathological myopia
- Choroidal dystrophies like gyrate atrophy and choroideremia.

Diminution of Vision for Near Only

A condition in which patient is not able to see near things with distant vision being normal.

Causes

- Presbyopia because of decrease in accommodation due to ageing
- Cycloplegia and ophthalmoplegia because of paralysis of accommodation.

COMPLAINTS NOT RELATED TO VISION

Redness

Acute red eye is seen in
- Acute conjunctivitis
- Acute iridocyclitis
- Acute congestive glaucoma
- Redness is a common symptom and it is seen in all inflammatory conditions of eye like blepharoconjunctivitis, all types of conjunctivitis, keratitis, uveitis, endophthalmitis, panophthalmitis, acute congestive glaucoma….

Watering

A condition in which eye appears wet with tears being overflowed from eyes.

Causes

- Hyperlacrimation due to either central lacrimation or primary hypersecretion or reflex hyperlacrimation.
- Epiphora due to obstruction in the lacrimal drainage system to normally formed tears. The site of block can be in punctum, canaliculi, lacrimal sac and nasolacrimal duct.

Discharge

Discharge from eye is seen in affection of mucosal surfaces of the eye (mucosal surfaces in the eye are conjunctiva and lacrimal sac).

It can be mucoid, mucopurulent, purulent, serosanguinous depending on the type of inflammation.
- Conjunctiva like conjunctivitis
- Lacrimal sac like acute and chronic dacryo cystitis.

Itching

It is mainly seen in allergic affections of eye like allergic conjunctivitis.

Ocular Pain

It is seen in inflammations of the eye or adnexal structures like keratitis, iridocyclitis, orbital cellulitis, internal hordeolum, external hordeolum .... and in acute congestive glaucoma.

Referred pain to the eye is seen in diseases involving the surrounding structures as in sinusitis, dental problems….

Headache

Ocular Causes for Headache

- Refractive errors (mainly mild uncorrected refractive errors and astigmatism), extraocular muscle imbalance, deficiency of accommodation and convergence insufficiency
- Ocular inflammations
- Glaucoma.

Nonocular Causes for Headache

- Neurological disorders like intracranial space occupying lesions meningitis, subarachnoid hemorrhage...
- ENT diseases like sinusitis, rhinitis... Psychiatric problems and migraine
- Primary headaches like migraine, cluster headache and tension headache.

Deviation of the Eye

It is called strabismus or squint. Misalignment of visual axes of the two eyes because of deviation of eyes is known as squint.

Protrusion of the Eyeball (Proptosis)

Forward displacement/protrusion of normal sized eyeball beyond the orbital margins is called proptosis.

Symptoms due to adnexa of the eye are described in Chapter 2.

CHAPTER

2

OCULAR EXAMINATION

Chapter Outline

- Head Posture
- Facial Symmetry
- Abnormal Facial Symmetry and Ocular Posture
- Visual Acuity
- Eyebrows
- Eyelids
- Lacrimal Apparatus
- Eyeball
- Examination of a Patient with Exophthalmos
- Examination of Binocular Extraocular Movements
- Conjunctiva
- Examination of Conjunctiva
- Cornea
- Sclera
- Anterior Chamber
- Iris
- Pupil
- Lens
- Fundus: Vitreous and Retina

Ocular examination is done under diffuse illumination using torch light and focal illumination using slit lamp.

Ocular examination should begin with the examination of head posture and facial symmetry as these can be altered by the patient voluntarily. They are best examined before the patient's realization that examination has begun.

HEAD POSTURE

Normal head posture: Normally head is kept in erect and straight posture without any tilt of the head or turn of the face or elevation/depression of chin or any abnormal movements of head.

> There are three pair of extraocular muscles, two horizontal recti, two vertical recti and two oblique muscles. When the movement of the eye is affected because of paresis or paralysis of the extraocular muscles, head posture acts as compensatory mechanism to compensate for the restricted eye movements to avoid diplopia.
>
> Restricted horizontal movements are compensated by face turn.
>
> Restricted vertical movements are compensated by elevation or depression of chin.
>
> Restricted oblique movements are compensated by head tilt.

> *Ocular torticollis:* It is defined as tilting of the head to compensate for defective ocular movements.
>
> True torticollis is due to contraction of sternocleidomastoid muscle.

Causes for Head Tilt

- Paresis/paralysis or restrictive causes affecting the oblique muscles.
- Superior oblique muscle paresis is the most common cause.

Causes for Face Turn

Paresis/paralysis or restrictive causes of medial rectus or lateral rectus (horizontal recti muscles).

Causes for Elevation of Chin

- Ptosis
- Paralysis of elevators (superior rectus and inferior oblique) of eyeball
- Overaction of depressors (inferior rectus and superior oblique) of eyeball.

Causes for Depression of Chin

- Paralysis of depressors of eyeball
- Overaction of elevators of eyeball.

FACIAL SYMMETRY

Both sides of the face are normally symmetrical in appearance

- With both eyebrows and eyelids at the same level
- With symmetrical nasolabial folds
- With angle of mouth of both sides symmetrical.

Causes for Facial Asymmetry

- Facial nerve palsy
- Unilateral ptosis—increased wrinkling of the forehead due to overaction of frontalis muscle on the ptotic side.

ABNORMAL FACIAL SYMMETRY AND OCULAR POSTURE (FIGS 2.1 TO 2.3)

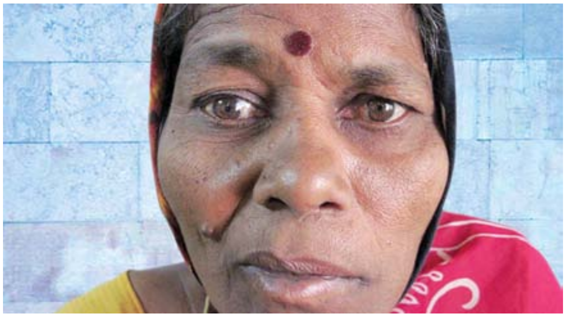


Fig. 2.1: Examination of a patient with facial nerve palsy. *Note:* Absence of wrinkling and nasolabial fold on left side of patient's face

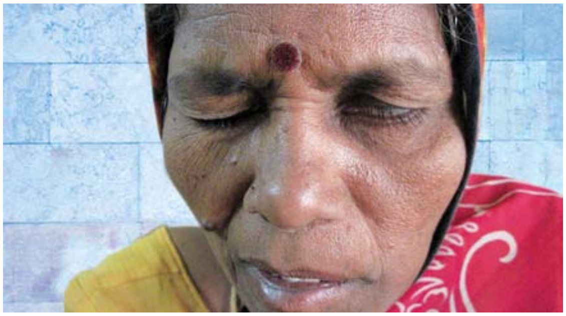


Fig. 2.2: On asking to close both eyes there is lagophthalmos of left eye

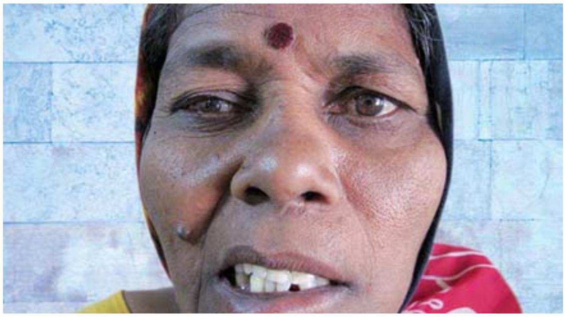


Fig. 2.3: On asking to clinch teeth there is deviation of angle of mouth to right side, i.e. normal side

Examination of a Patient with Third Nerve Palsy (Figs 2.4 and 2.5)

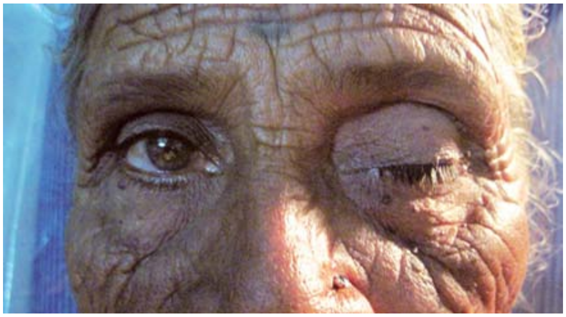


Fig. 2.4: A patient with third nerve palsy. *Note:* Ptosis of left upper eyelid

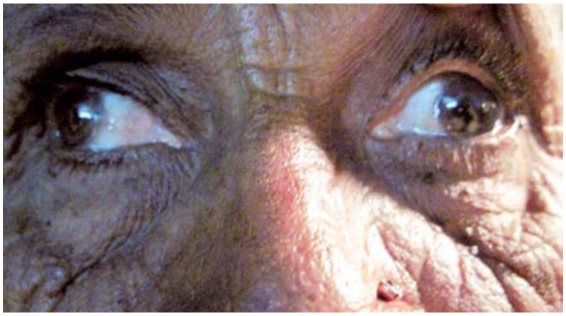
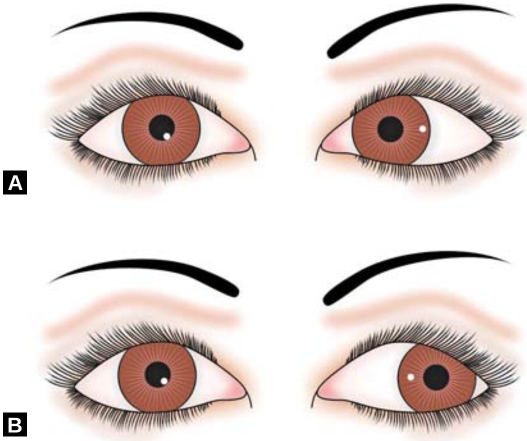


Fig. 2.5: On lifting the ptotic eyelid manually left eyeball is deviated downwards and outwards because of the action of superior oblique and lateral rectus which are supplied by 4th and 6th nerves respectively

Ocular Posture



Figs 2.6A and B: Left eye: (A) Esotropia; (B) Exotropia

Normally visual axes of the two eyes are parallel to each other in primary position and the same is maintained in all positions of gaze. This condition of perfect alignment of eyes is called orthophoria.

Misalignment of visual axes of eyes is called squint (strabismus).

- Inward deviation of the eye—esotropia **(Figs 2.6A and 2.8)**
- Outward deviation of the eye—exotropia **(Figs 2.6B and 2.7)**
- Vertical deviation of the eye—hypertropia.

VISUAL ACUITY

Visual acuity is defined as the ability to distinguish the shape of objects. It is a retinal function concerned with the appreciation of form sense.

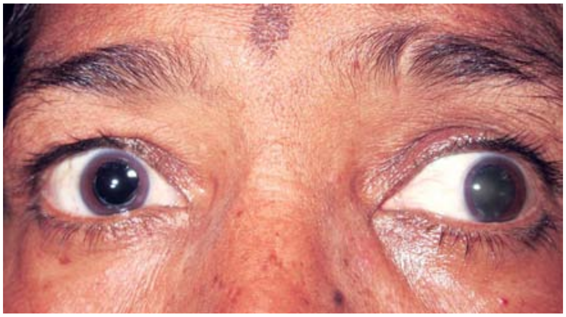


Fig. 2.7: Exotropia of left eye. *Note:* Outward deviation of left eye

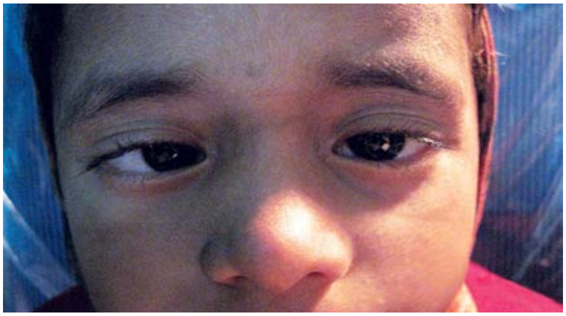


Fig. 2.8: Esotropia of right eye. *Note:* Inward deviation of right eye

Testing visual acuity involves testing both distance vision and near vision.

Testing Distance Vision

Bedside: In the absence of charts designed for testing visual acuity it can be assessed roughly by counting fingers by standing at a distance of 6 meters and if the patient is not able to count fingers at 6 meters, examiner moves towards the patient reducing the distance between him and the patient by 1 meter each time till the patient is able to count the fingers.

- Counting fingers > 6 m
- Counting fingers at 6 m
- Counting fingers at 5 m
- Counting fingers at 4 m
- Counting fingers at 3 m
- Counting fingers at 2 m
- Counting fingers at 1 m
- Counting fingers at 1 feet
- Counting fingers close to face
- Hand movements
- Perception of light with projection of rays in all the quadrants
- Perception of light negative.

Counting fingers at 6 meters is roughly equal to 6/60 (top most line) with Snellen's chart.

The size of the top most letter is roughly equal to the size of the fingers, hence by counting of fingers at bedside vision can be assessed up to 6/60 of Snellen's chart.

Visual Acuity Charts

Snellen's chart is the commonly used chart for measurement of visual acuity.

Two distant points can be visible as separate when they subtend an angle of 1 minute at the nodal point of the eye.

Snellen's chart consists of series of black letters arranged in progressively decreasing in size. The letters selected are such that each letter will subtend an angle of 1 minute at the nodal point of the eye.

The top letter can be read from a distance of 60 meters, the succeeding lines can be read from 36, 24, 18, 12, 9, 6, 5 and 4 meters respectively.

Procedure

- Patient is seated at a distance of 6 meters, and the patient is asked to read the chart separately in each eye after closing one eye. Visual acuity is recorded as a fraction of which numerator is distance of the patient from the chart and denominator is smallest letters which the patient reads which is written below the letters, i.e. 60, 36, 24…
- If the patient is not able to read the top most line from 6 meters he is asked to move by 1m front till he can see the top most line clearly, then numerator becomes 5, 4, 3, 2, 1… If the

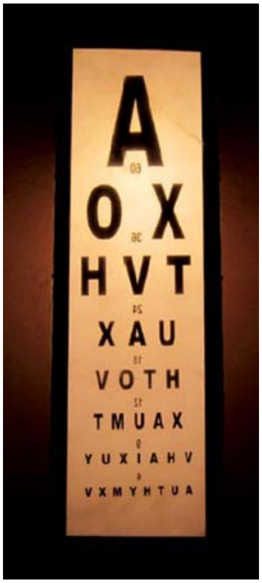


Fig. 2.9: Snellen's distance visual acuity chart

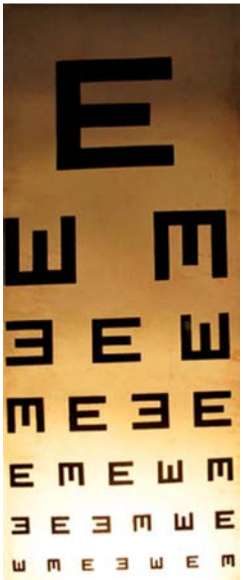


Fig. 2.10: E chart

patient cannot read from 1 meter then check for:

- Counting fingers at 1 feet
- Counting fingers close to face
- Hand movements
- Perception of light with projection of rays in all the four quadrants
- Perception of lights negative.

Why 6 meters?

At 6 meters the rays of light are practically parallel and the patient exerts minimum accommodation. Hence 6 meters is choosen.

The same can be acheived by placing a plane mirror at 3 meters and the patient is asked to read the reflected image in the mirror which makes it 6 meters.

The other visual acuity charts available other than Snellen's letter chart are:

- Snellen's E chart
- Landolt's C chart
- Allen's picture chart

Testing Near Vision

Near vision is tested by near vision chart by asking the patient to read this from a distance of 30 cm the routine working distance in each eye separately. The smallest letters which the person can read is recorded as the near vision of the person. Normal near vision is N6 **(Fig. 2.11)**.

Near vision charts

Jaeger's near vision chart
Roman's near vision chart
Snellen's near vision chart

Testing Color Vision

Pseudoisochromatic charts (Ishihara's plates). The person is asked to read the numbers in the color plates.

Normal people can read all the plates (normally 6 screening plates) correctly whereas people with color blindness will read it wrong as shown in the following Table **(Fig. 2.12)**.

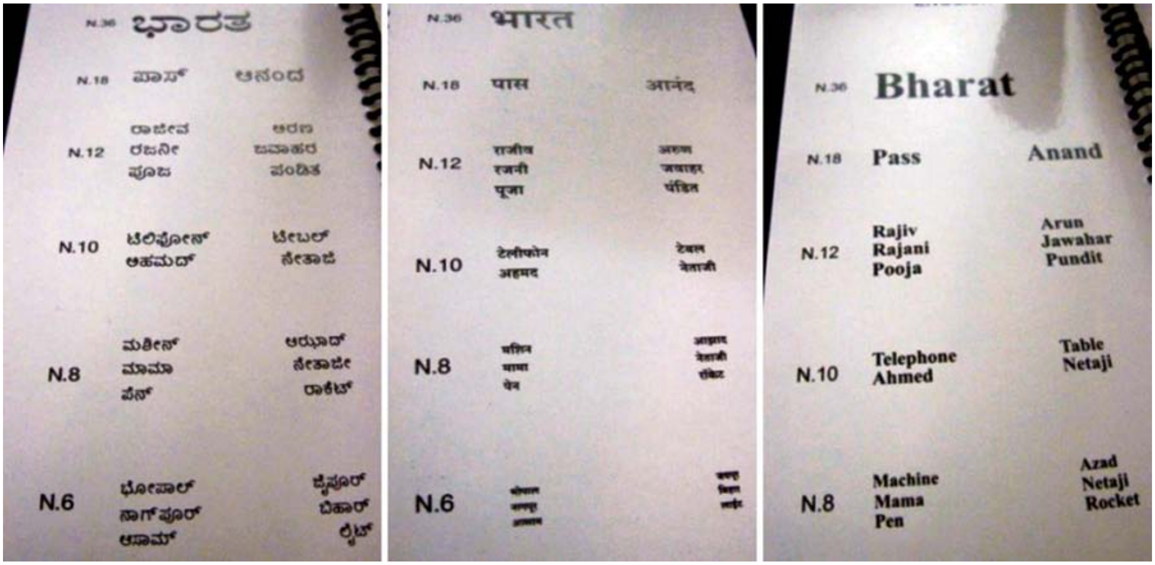

N.36 भारत
N.18 पास आनंद
N.12 राजीव रजनी पूजा
N.10
N.8
N.6
N.36 Bharat
N.18 Pass Anand
N.12 Rajiv Rajani Pooja Arun Jawahar Pundit
N.10 Telephone Ahmed Table Netaji
N.8 Machine Mama Pen Azad Netaji Rocket

Fig. 2.11: Near vision charts in different languages

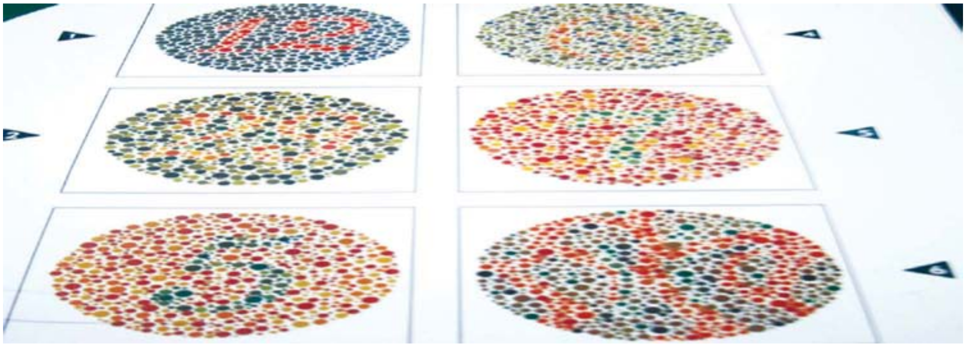


Fig. 2.12: Color vision chart

	Person with normal color vision	*Person with red green color blindness*	*Person with total color blindness*
Plate 1	12	12	12
Plate 2	29	70	X
Plate 3	5	2	X
Plate 4	6	X	X
Plate 5	7	X	X
Plate 6	X	5	X

X - Not able to identify the letter will say as empty plate

- Other methods for testing color vision
  Farnsworth-Munsell 100 hue test
  Nagel's anomaloscope.

Testing Visual Field

- Confrontation test
- Perimetry

Visual acuity is recorded under the following headings:

	RIGHT EYE	*LEFT EYE*
• Distance vision		
With naked eye		
With pinhole (if the visual acuity is less than 6/6)		
With spectacles (if the patient is wearing spectacles)		
• Near vision		

Pinhole test

If the distance vision is less than 6/6 all patients should be asked to look through a pinhole and improvement if any in visual acuity should be recorded.

A pinhole cuts off all the peripheral rays and allows only central parallel beam of rays to enter eye and visual improvement is seen in cases of refractive errors.

If the cause for diminution of vision is not refractive error like cataract then improvement in vision is not seen. The results of pinhole test can be summarized as.

Visual acuity improves with pinhole—cause is refractive error which can be corrected by appropriate refraction and correction.

No improvement in visual acuity with pinhole-causes are corneal causes like corneal opacity, corneal edema… and causes in lens like cataract…

Decrease in visual acuity with pinhole-central corneal opacity, central lens opacity, macular pathologies…

The size of the pinhole is 1 mm.

EYEBROWS

Normally, the eyebrows are symmetrically placed on each side of the face above the eyelids.

Each eyebrow will be curved with convexity upwards, covered with hair arranged in comma shape.

Eyebrows are symmetrical collection of hair follicles along supraciliary arch.

Eyebrows separate the eyelids from forehead and they form a part of protective mechanism of the eyes along with eyelids.

Being symmetrically placed on each side of the face they contribute for the facial configuration.

Abnormalities

Alteration in Position of Eyebrows

- Raised on the side of ptosis because of overaction of frontalis muscle on that side.

Eyebrows with scanty hair follicles

- Leprosy, syphilis (usually lateral one-third of eyebrows are scanty or absent)
- Hypothyroidism or hyperthyroidism
- Localized loss of eyebrows follow trauma, infections of skin, scars.

Graying of eyebrows

- Poliosis (gray eyebrows)—unilateral vitiligo, VKH syndrome (Vogt-Koyanagi-Harada syndrome).

EYELIDS

Each eyelid should be examined for position, margin, movements, palpebral fissure width, eyelashes and abnormalities of skin of the eyelids **(Fig. 2.13)**.

Position

Normally the upper eyelid covers about 1/6th of cornea, i.e. 2 mm and lower eyelid touches the inferior limbus.

In ptosis upper lid covers more than 2 mm of cornea.

In lid retraction upper lid is abnormally elevated hence superior limbus will be visible. (This is called scleral show and the most common cause is hyperthyroidism) **(Figs 2.14 and 2.15)**.

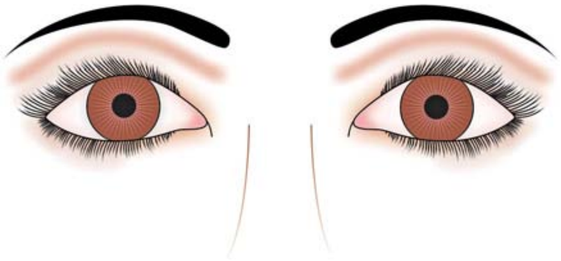


Fig. 2.13: Normal eyelids

Normal position—upper eyelid covering 1/6th of cornea.
—lower eyelid touching the lower limbus.

Normal margins —lids have a rounded arterior border and a sharp posterior border touching the globe.

Normal eyelashes—eyelashes in the upper eyelid are directed forwards, upwards and backwards and in the lower eyelid are directed forwards, downwards and backwards.

Abnormalities in Eyelid

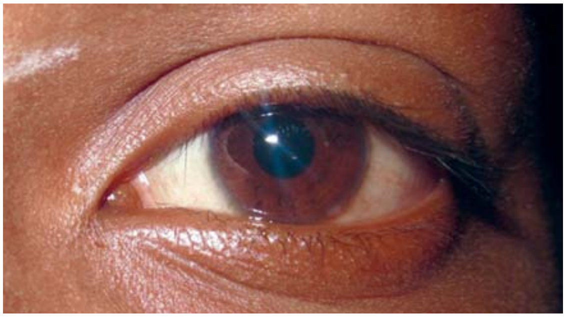


Fig. 2.14: Normal position of eyelids. *Note:* Upper eyelid covers 2 mm of cornea and lower eyelid touches the inferior limbus

Margin

Normally the eyelids have a rounded anterior border and a sharp posterior border. The lateral portion (ciliary portion) has eyelashes and medial portion (lacrimal portion) is devoid of eyelashes.

Entropion: Inward turning of lid margin.

Ectropion: Outward turning of lid margin.

Tylosis: Thickened eyelid margin.

Epicanthus: Semicircular fold of skin covering the medial canthus.

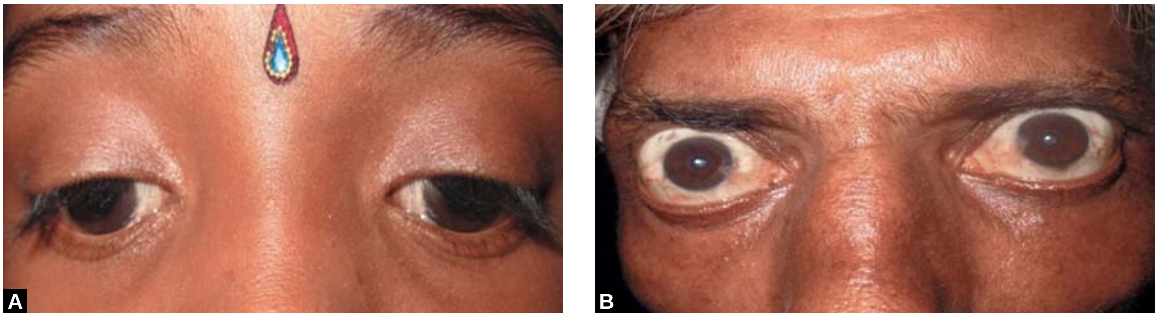
Telecanthus: Increased distance between the two medial canthi because of long medial canthal tendons.

Movements

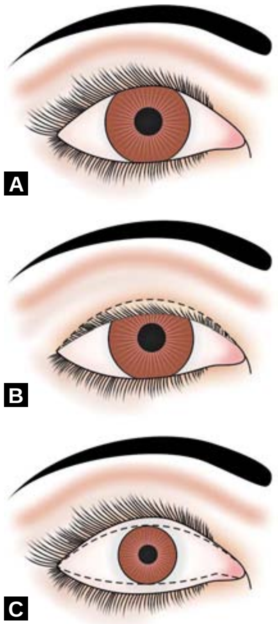
Eyelids have got involuntary movement called blinking. The normal blink rate is 12–16 blinks per minute.

Increased blink rate is seen in blepharospasm. The causes for blepharospasm are essential blepharospasm and reflex blepharospasm.

Decreased blink rate is seen in lagophthalmos (inability to close eyelids completely). The causes for lagophthalmos are facial nerve palsy, symblepharon…



Figs 2.15A and B: Abnormal position of the eyelids (A) Bilateral ptosis. *Note:* Drooping of upper eyelids, upper eyelid covering more than 2 mm of cornea; (B) Bilateral retraction. *Note:* Upper eyelid covers less than 2 mm of cornea hence upper limbus is visible scleral show

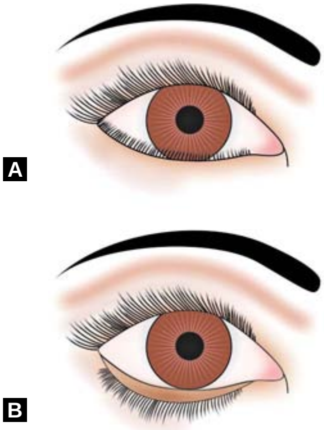


Normal position of eyelids
- Upper lid covering 1/6th of cornea
- Lower lid touching limbus

Ptosis of upper eyelid
- Upper lid covering more than 1/6th of cornea

Retraction of eyelids
- Both upper limbus and lower limbus visible because of upward movement of upper lid and downward movement of lower lid

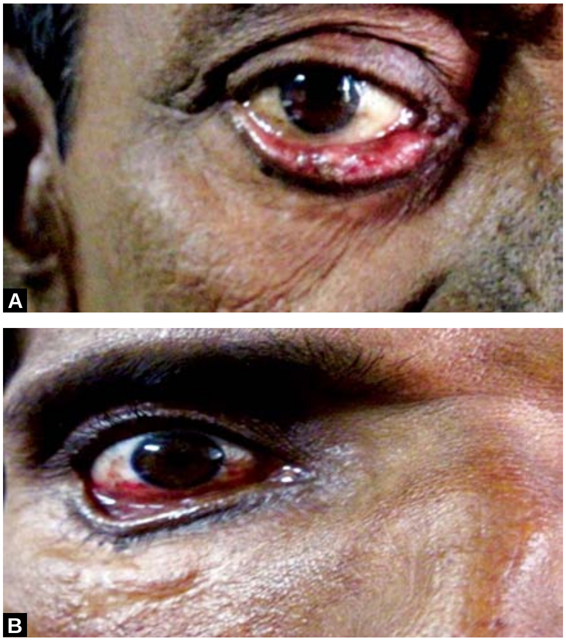
Figs 2.16A to C: (A) Normal position of eyelids; (B) Ptosis of upper eyelids; (C) Retraction of eyelids



Figs 2.17A and B: (A) Entropion. *Note:* Inward turning of lower eyelid margin wih eyelashes touching the globe; (B) Ectropion. *Note:* Outward turning of lower eyelid margin with exposure of lower conjunctival fornix

Palpebral Aperture Width

Normal palpebral aperture width is vertical 10 mm and horizontal 30 mm **(Fig. 2.20)**.



Figs 2.18A and B: (A) Ectropion of the lower eyelid; (B) Cicatrical ectropion of lower eyelid. *Note:* The scar over the skin

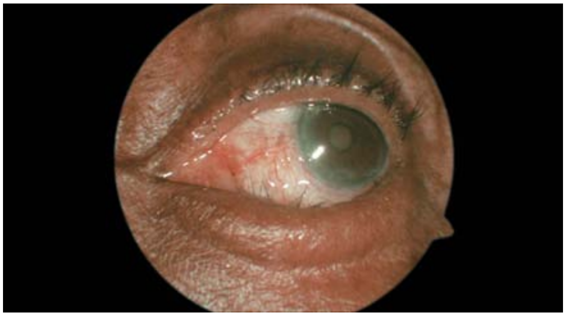


Fig. 2.19: Entropion of lower eyelid

All round narrow palpebral fissure width is seen in blepharophimosis.

Horizontally narrow palpebral fissure width is seen in ankyloblepharon.

Vertically narrow palpebral fissure width is seen in ptosis, phthisis bulbi…

Vertically wide palpebral fissure width is seen in proptosis.

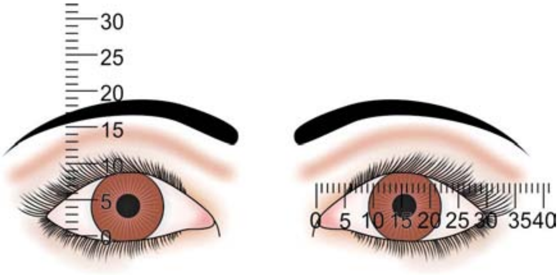


Fig. 2.20: Measuring palpebral fissure width (vertical); Measuring palpebral fissure width (horizontal)

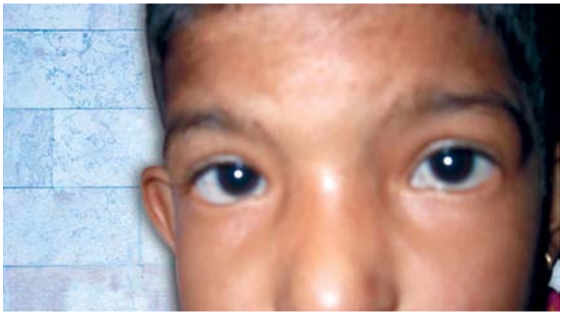


Fig. 2.21: Blepharophimosis syndrome consisting of ptosis, blepharophimosis, epicanthus inversus, telecanthus

Eyelashes

Normally eyelashes in the upper eyelid are directed forwards, upwards and backwards and in the lower eyelid they are directed forwards, downwards and backwards.

Trichiasis: Misdirected eyelashes **(Fig. 2.22A)**.

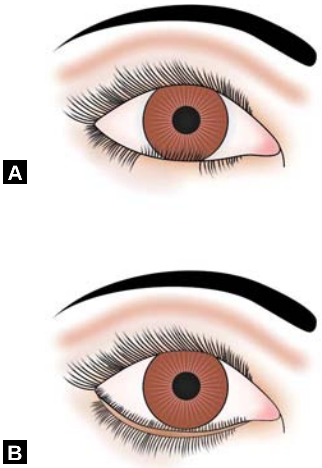
Distichiasis: Congenital presence of abnormal posterior row of eyelashes **(Fig. 2.22B)**.

Madarosis: Absence of eyelashes seen in ulcerative blepharitis, leprosy, myxoedema, syphilis.

Poliosis: Graying of eyelashes seen in sarcoidosis, sympathetic ophthalmitis, Vogt-Koyanagi-Harada syndrome

Skin: Normally skin of eyelid is thin, smooth and elastic.

Common eyelid swellings are chalazion, external and internal hordeolum, lid tumors…



Figs 2.22A and B: (A) Trichiasis. *Note:* Inward misdirected lower eyelid lashes touching the cornea; (B) Distichiasis. *Note:* Abnormal extra row of eyelashes in lower eyelid

Cryptophthalmos: Hidden eyeball, i.e. eyeball is covered by a layer of skin.

It is a rare congenital anomalous condition resulting from failure of eyelid formation.

The skin of the eyelid is thinnest in the body. The subcutaneous areolar tissue is loose hence is easily distended by blood. Thus, black eye (collection of blood in the subcutaneous areolar layer) is commonly seen in injuries involving the face and head.

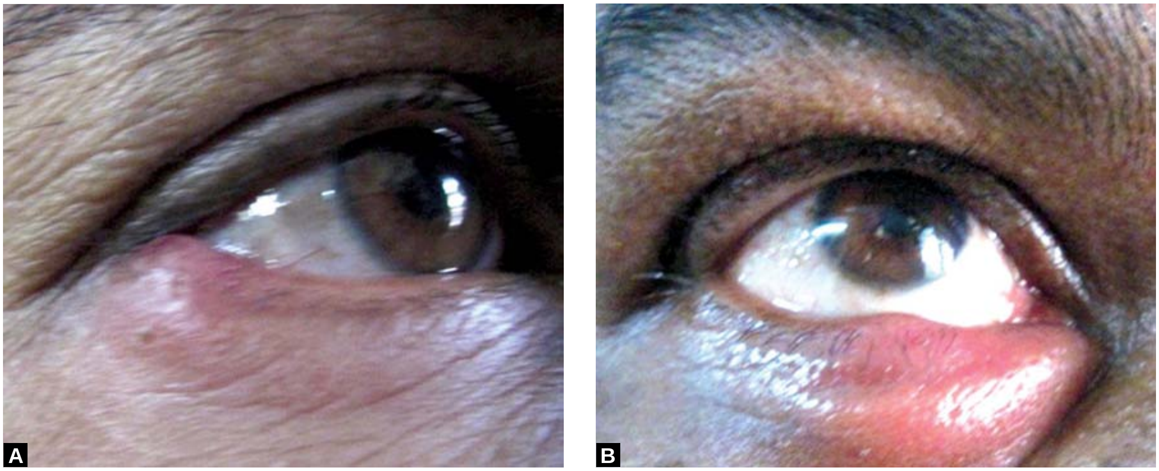
LACRIMAL APPARATUS

Lacrimal apparatus consists of lacrimal secretory system and lacrimal drainage system. Lacrimal secretory system consists of main lacrimal gland situated in the anterolateral part of the roof of the orbit and accessory lacrimal glands situated in the subconjunctival tissue.

Lacrimal drainage system consists of puncta, canaliculi, lacrimal sac and nasolacrimal duct.

Examination of lacrimal drainage system is done by

Inspection of lacrimal puncta situated one each in upper and lower eyelids.



Figs 2.23A and B: Internal hordeolum. *Note:* Localized swelling presenting on the conjunctival side of the lower eyelid away from lid margin with inflammatory signs

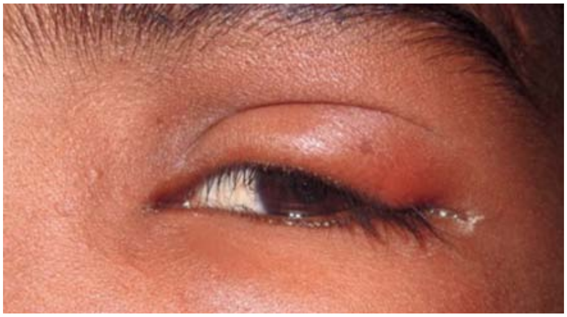


Fig. 2.24: External hordeolum. *Note:* Localized swelling presenting on the skin side of the lower eyelid at lid margin with inflammatory signs

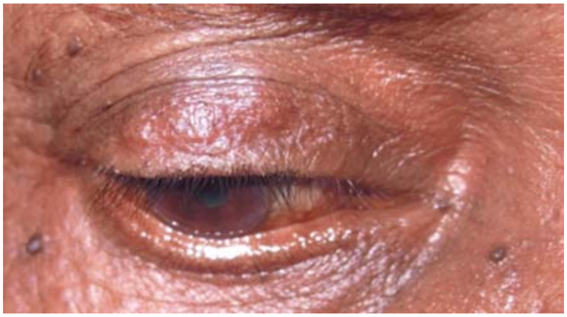


Fig. 2.26: Multiple chalazion of upper eyelid

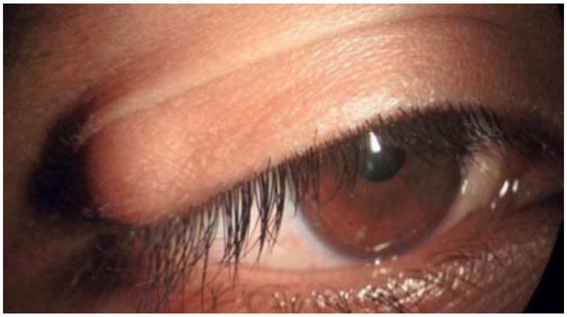


Fig. 2.25: Chalazion. *Note:* Localized swelling presenting on the conjunctival side, away from lid margin of upper eyelid with no inflammatory signs

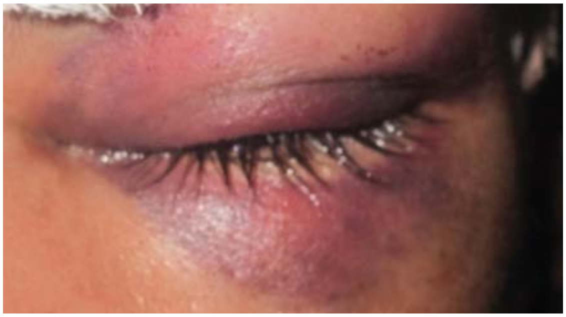


Fig. 2.27: Ecchymosis of eyelids (Black eye)

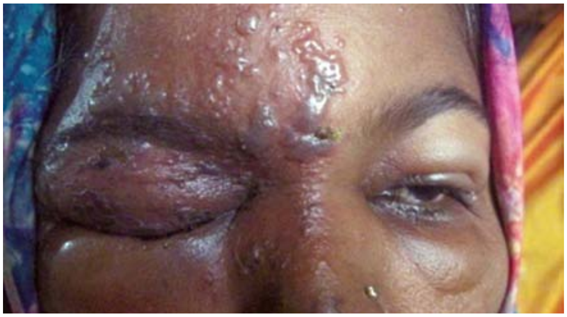


Fig. 2.28: Herpes zoster ophthalmicus. *Note:* Vesicular lesions strictly not crossing the midline with involvement of tip of the nose and involvement of skin of the eyelids (Hutchinson's rule—ocular involvement is present if the tip of the nose is involved as both are supplied by nasociliary nerve)

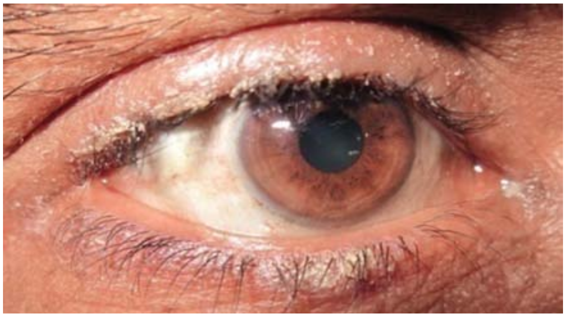


Fig. 2.29: Squamous blepharitis. *Note:* The presence of yellow crusts seen along the eyelashes

Abnormalities of lacrimal puncta can be absence, eversion, stenosis of punctum.

Inspection of skin over lacrimal sac area for redness, swelling, fistula…

Regurgitation test

Apply pressure over the lacrimal sac area with either thumb or index finger and look for the regurgitation of fluid or discharge from upper or lower punctum.

Normally, it is negative, i.e. no regurgitation of fluid or discharge.

Regurgitation of fluid or discharge is called positive regurgitation test and it indicates chronic dacryocystitis.

In chronic dacryocystitis with encysted mucocele there is no regurgitation of the contents leading to false negative test.

EYEBALL

Eyeball has to be examined under the headings, position, size and movements of the eyeball.

Position

Normally two eyeballs are suspended in the orbit by four recti muscles and two oblique muscles.

Abnormalities in position of eyeball: proptosis and enophthalmos

Proptosis: Forward displacement/protrusion of normal sized eyeball beyond orbital margins.

Proptosis caused by thyroid disease is called exophthalmos. It is the most common cause for unilateral or bilateral proptosis in adults. In children orbital cellulitis is the most common cause for unilateral proptosis and neuroblastoma or leukemia for bilateral proptosis.

Proptosis is because of mass lesions pushing the eyeball forwards. The direction of displacement depends on the direction of mass lesion. Axial proptosis is due to retrobulbar space occupying lesions, eccentric proptosis is due to mass lesion in the peribulbar space or surrounding structures (eyeball will be pushed in the direction opposite to that of mass lesion), e.g. Mass in maxillary sinus will cause proptosis in upward direction **(Figs 2.30 and 2.31)**.

Causes of Proptosis

Unilateral Proptosis

- Congenital causes like dermoid cyst, orbital teratoma...
- Traumatic causes like orbital hemorrhage, orbital emphysema...
- Inflammations like orbital cellulitis, pseudotumor...
- Tumors primary or metastatic
- Cysts involving the orbit like parasitic cysts...
- Vascular malformations like orbital varices, carotid cavernous fistula...
- Endocrine diseases like Grave's disease.

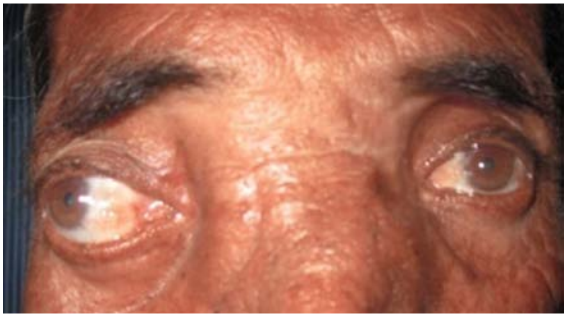


Fig. 2.30: Eccentric proptosis

Bilateral Proptosis

- Anomalies of skull like craniofacial dysostosis...
- Systemic diseases like histiocytosis, amyloidosis…
- Tumors like lymphoma, leukemia or secondaries from neuroblastoma, nephroblastoma...
- Exophthalmos because of thyroid ophthalmopathy.
- Inflammations like cavernous sinus thrombosis.

Acute Proptosis

- Seen following trauma because of orbital hemorrhage, orbital emphysema…

Pulsating Proptosis

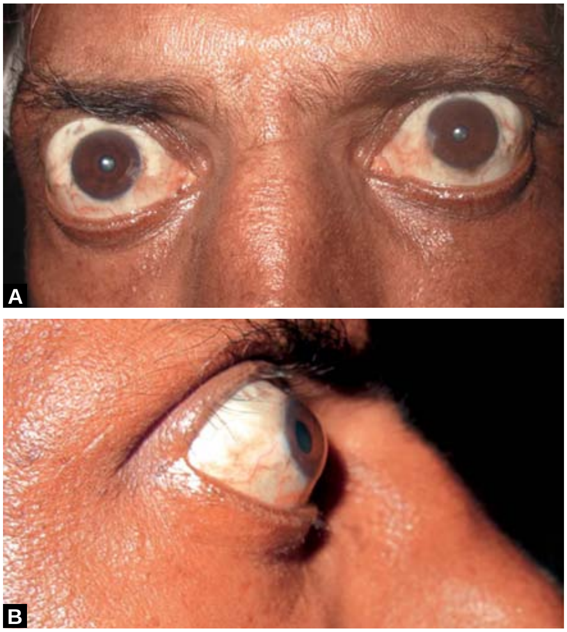
- Carotid-cavernous fistula
- Aneurysm of ophthalmic artery

Intermittent Proptosis

- Orbital varices
- Lymphangioma

Exophthalmometry

- Measurement of proptosis/exophthalmos
- *By plastic scale:* A plastic scale is placed tightly on the lateral orbital margin and the level of the apex of the cornea is read from the scale.
- Normal 16 mm
- Borderline 16–20 mm
- Proptosis >21 mm or difference of more than 2 mm between two eyes
- *Instruments to measure proptosis:*
- Luedde's exophthalmometer, Hertel's exophthalmometer.



Figs 2.31A and B: Bilateral axial proptosis

Ocular signs in exophthalmos

- *Dalrymple's sign:* Lid retraction
- *Von Graefe sign:* Upper lid lag on down gaze
- *Grove sign:* Resistance of upper lid to downward traction
- *Gifford sign:* Difficult to evert upper eyelid
- *Griffith sign:* Lower lid lags behind the globe on up gaze
- *Kocher's sign:* Staring look of eyes
- *Rosenbach sign:* Tremors of closed eyelid
- *Stellwag sign:* Infrequent blinking
- *Jellinek sign:* Increased pigmentation of upper eyelid
- *Joffroy's sign:* Decreased wrinkling on forehead on upgaze
- *Enroth sign:* Fullness of eyelids
- *Mobius sign:* Convergence weakness.

Enophthalmos

It is inward displacement of the eyeball.

Decrease in the orbital contents will cause enophthalmos as in

EXAMINATION OF A PATIENT WITH EXOPHTHALMOS

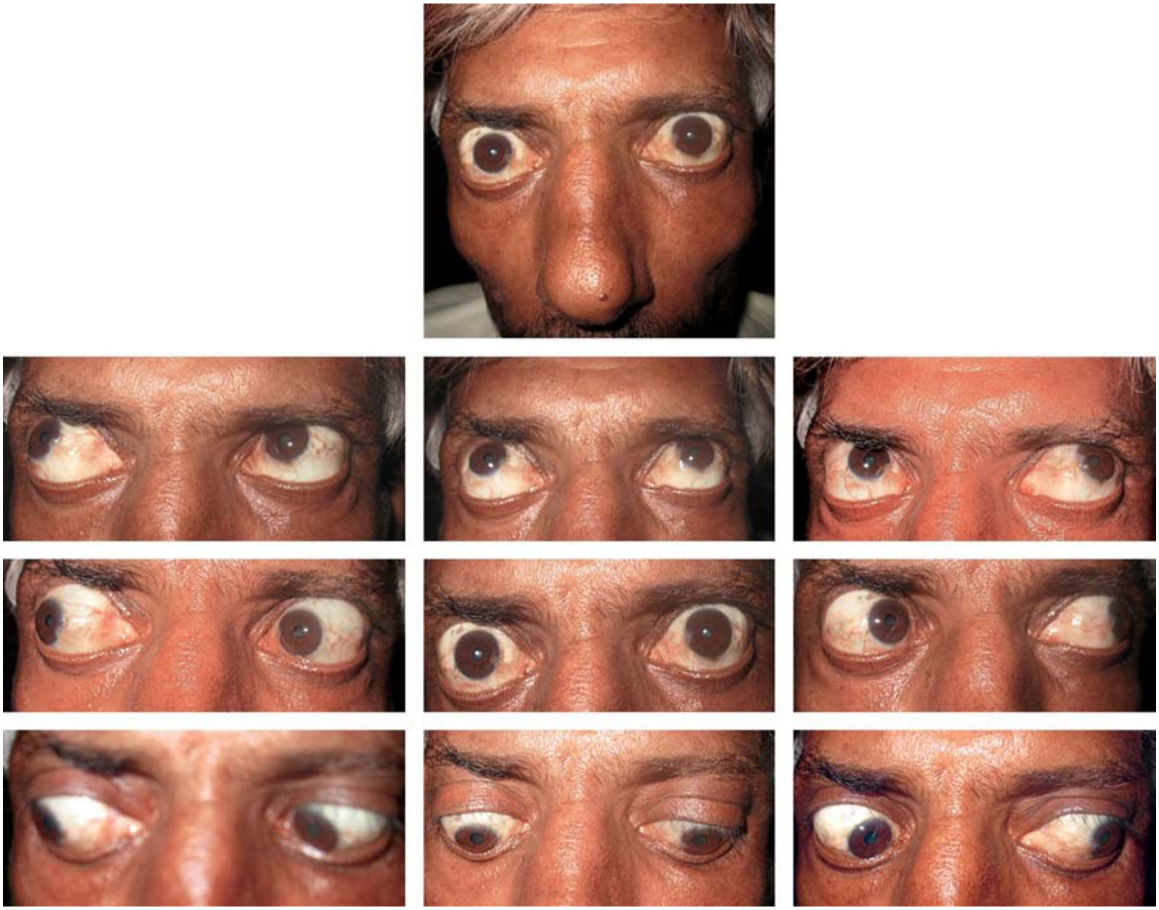


Fig. 2.32: Examination of a patient with exophthalmos. *Note:* Lid retraction, scleral show, decreased wrinkling on forehead, staring look, upper eyelid lag on down gaze

- Blow out fractures due to loss of orbital contents
- Atrophy of orbital contents as in senile atrophy of orbital fat or atrophy following irradiation of malignant orbital tumor.

Pseudoproptosis

It is a condition in which eye appears to be proptosed due to enlargement of the eyeball as in high axial myopia.

Size of the Eyeball

Normal dimensions

- Anteroposterior diameter 24 mm
- Vertical diameter 23 mm
- Horizontal diameter 23.5 mm

Anteroposterior diameter is measured by A-scan.

Increased size of eyeball

- High myopia
- Buphthalmos

Decreased size of eyeball
- Microphthalmos
- Phthisis bulbi
- Atrophic bulbi **(Figs 2.33A and B)**

Movements of Eyeball

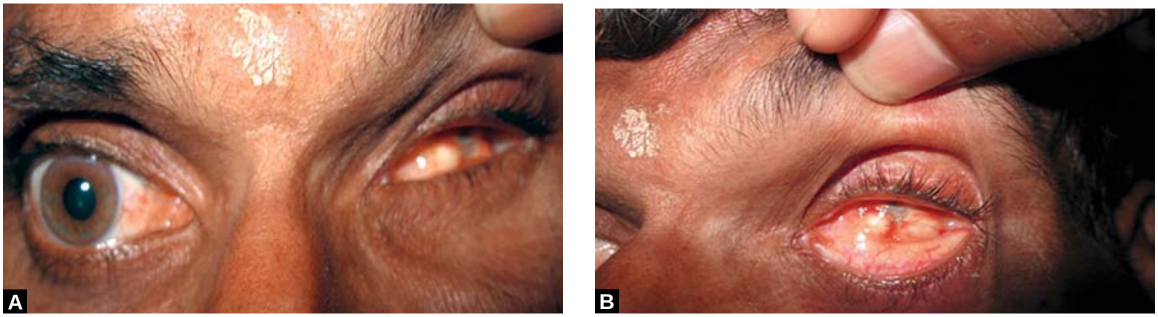
Uniocular movements (ductions) and binocular movements (versions and vergence) have to be tested.

Ocular movements can be limited or restricted.

Limited ocular movements are because of paresis or paralysis of the nerves supplying the extraocular muscles.

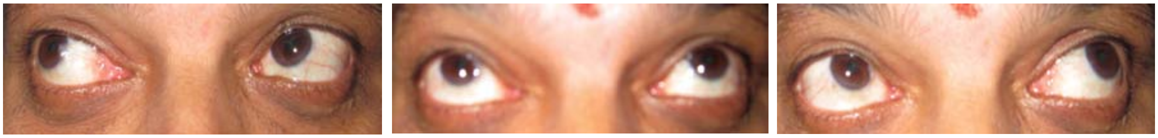
Example: Third nerve paresis, forth nerve paresis…

Restricted ocular movements are because of mass lesions outside the muscle restricting the movement of the muscle **(Figs 2.34 and 2.35)**.

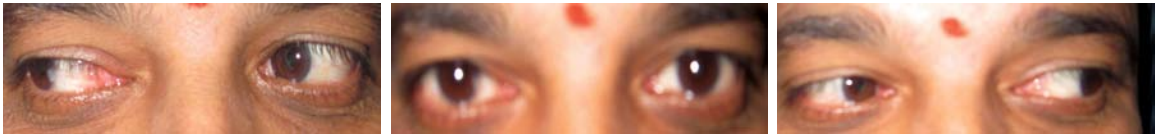


Figs 2.33A and B: Phthisis bulbi—sizeless, shapeless, sightless, soft and shrunken eyeball

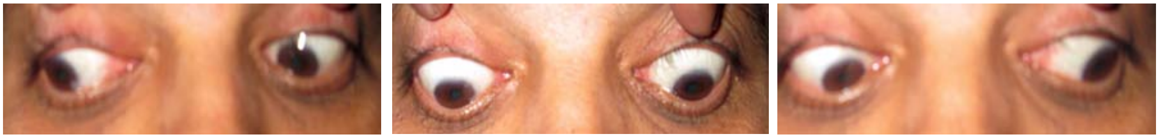
EXAMINATION OF BINOCULAR EXTRAOCULAR MOVEMENTS



Dextroelevation Supraversion Levoelevation

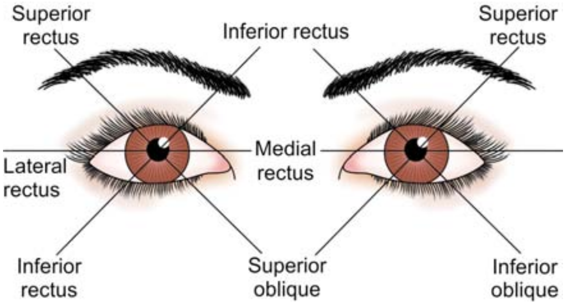


Dextroversion Primary position Levoversion



Dextrodepression Infraversion Levodepression

Fig. 2.34: Examination of binocular extraocular movements



Figs 2.35: Ocular movements

CONJUNCTIVA

Conjunctiva is a mucous membrane lining the posterior aspect of the eyelids and anterior surface of sclera.

Conjunctiva is examined under the headings

- Bulbar conjunctiva
- Palpebral conjunctiva
- Conjunctival fornices.

How to examine conjunctiva?

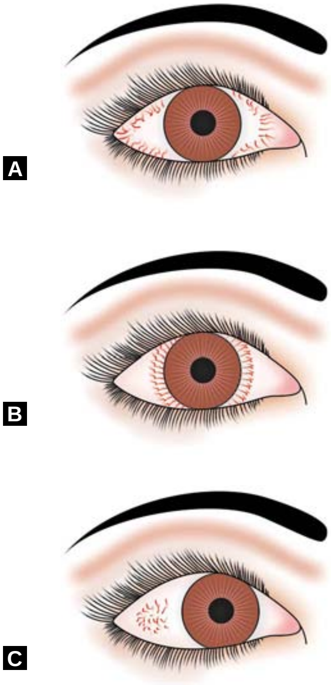
Bulbar conjunctiva, lower palpebral conjunctiva and conjunctival fornices (except superior fornix) can be examined by retracting the upper lid and lower lid with index finger/thumb.

Upper palpebral conjunctiva is examined by eversion of the upper lid. Eversion of the upper eye lid is done by everting the upper eyelid by holding the lid margin with one hand or using two hands.

Superior fornix is examined after double eversion of upper lid using Desmarres lid retractor.

Abnormalities of Conjunctiva

- Congestion
- Chemosis
- Discoloration
- Follicles
- Papillae
- Pterygium
- Pinguecula
- Conjunctival cysts and tumors
- Xerosis of conjunctiva.



Figs 2.36A to C: (A) Conjunctival congestion; (B) Circum ciliary congestion; (C) Scleral congestion

Congestion

Conjunctival congestion (Fig. 2.36A): Because of conjunctival vessels seen in acute conjunctivitis, allergic conjunctivitis…

Congested vessels are bright red in color, superficial and branching, move on moving conjunctiva, blanch with phenylephrine and more marked in fornices.

Ciliary congestion (Fig. 2.36B): Because of ciliary vessels seen in keratitis, iridocyclitis…

Congested vessels are purplish or dull red in color, deep and radiating, will not move on moving the conjunctiva, will not blanch with phenylephrine and more marked around limbus.

Scleral congestion (Fig. 2.36C): Because of ciliary vessels seen in episcleritis and scleritis.

Congestion is limited to a sector or a quadrant, congested vessels are dull red in color, conjunctiva can be moved over the congested vessels and vessels will not blanch with phenylephrine.

EXAMINATION OF CONJUNCTIVA

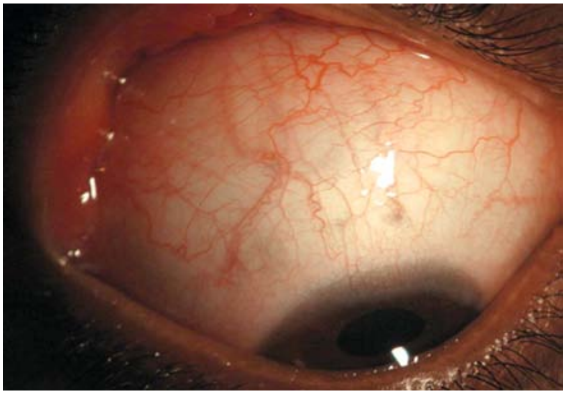


Fig. 2.37A: Examination of superior bulbar conjunctiva and superior fornix by asking the patient to look down

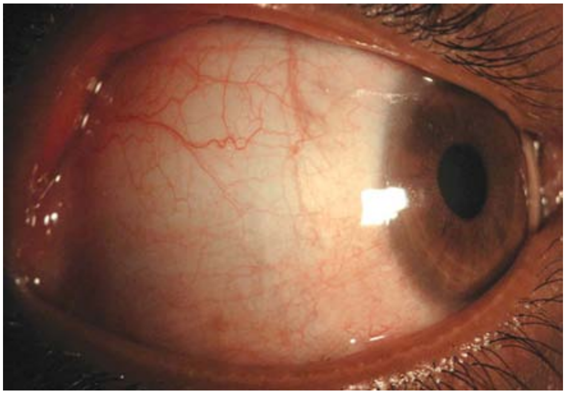


Fig. 2.37B: Examination of nasal bulbar conjunctiva and medial fornix by asking the patient to look temporally

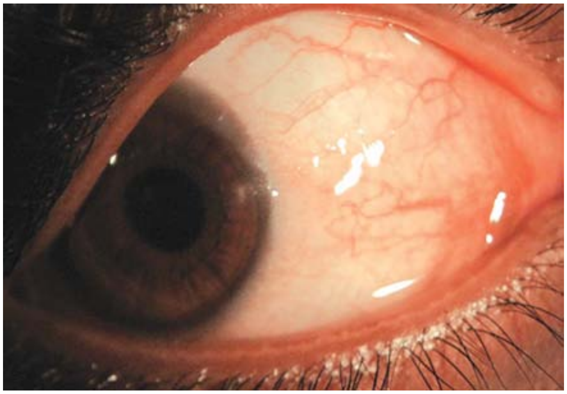


Fig. 2.37C: Examination of temporal bulbar conjunctiva and lateral fornix by asking the patient to look nasally

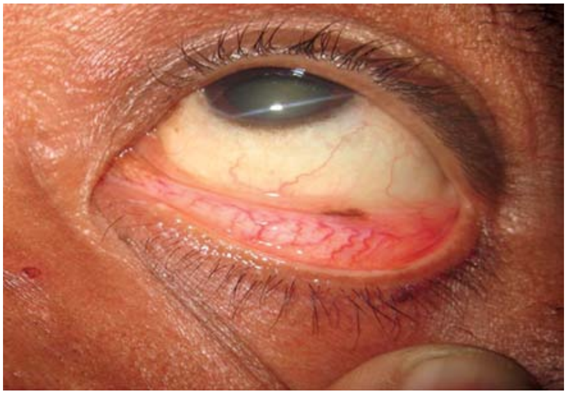


Fig. 2.37D: Examination of inferior palpebral conjunctiva and inferior conjunctival fornix by asking the patient to look up and pulling the lower lid downwards

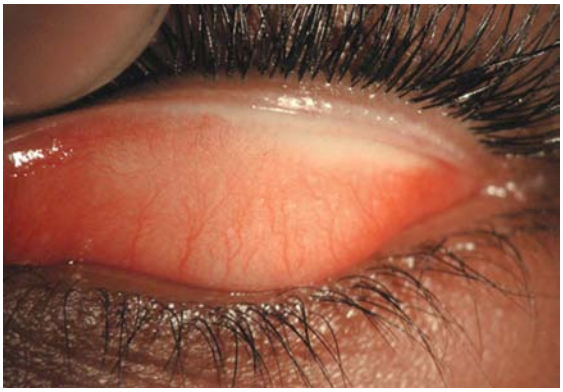
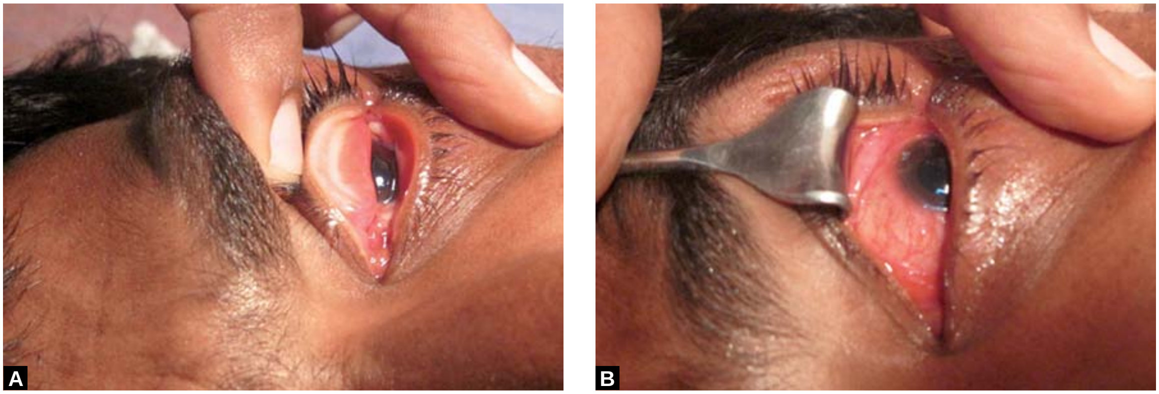


Fig. 2.37E: Examination of upper bulbar conjunctiva by eversion of the upper eyelid



Figs 2.38A and B: Examination of superior fornix by using Desmarres lid retractor

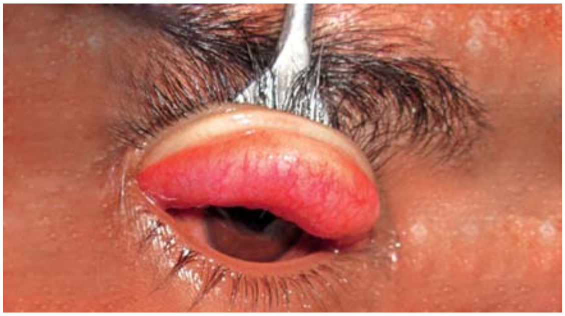


Fig. 2.39: Double eversion of the upper eyelid using Desmarres lid retractor

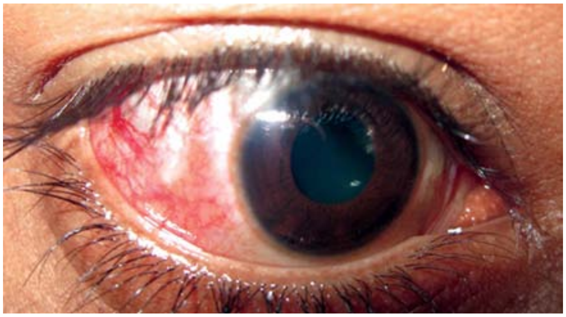


Fig. 2.41: Sectoral congestion in a patient with episcleritis

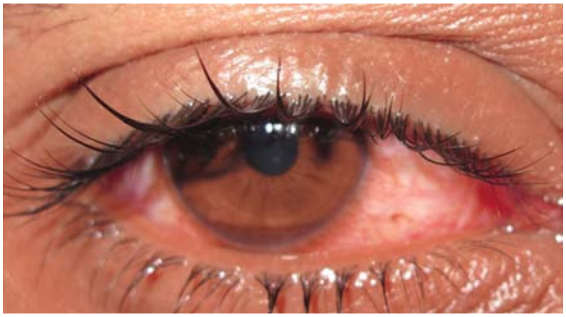


Fig. 2.40: Conjunctival congestion in a patient with acute conjunctivitis

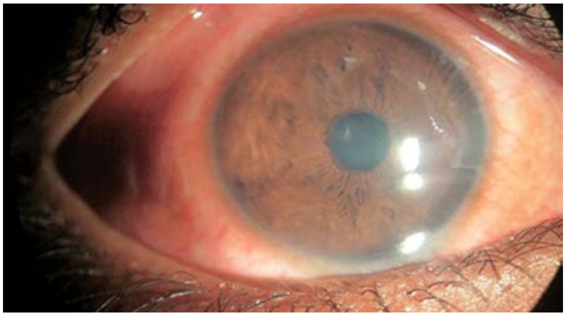


Fig. 2.42: Ciliary congestion in a patient with anterior iridocyclitis

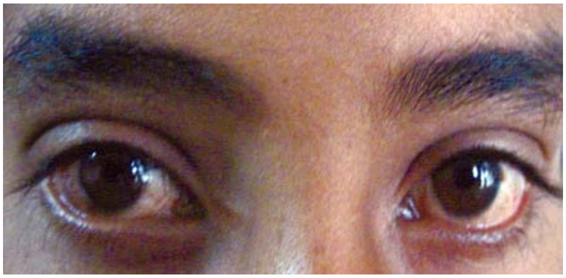
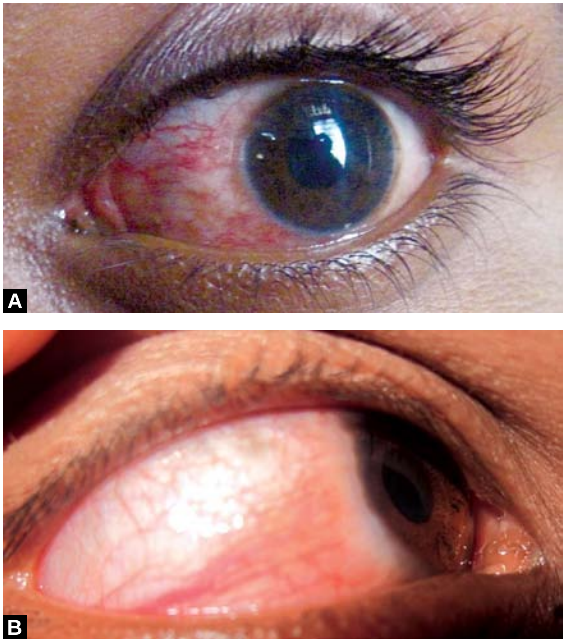


Fig. 2.43: Dusky red congestion seen in allergic conjunctivitis



Figs 2.44A and B: Gelatinous thickening around limbus seen in bulbar form of vernal conjunctivitis

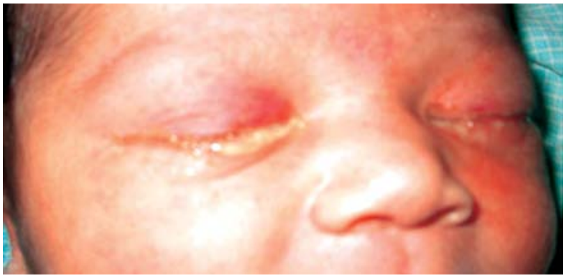


Fig. 2.45: An infant with ophthalmia neonatorum

Chemosis

Edema of the conjunctiva

Causes:

Ocular inflammations, such as conjunctivits, keratitis, iridocyclitis, endophthalmitis, panophthalmitis, orbital cellulitis…

As a part of generalized edema as in heart failure, hypoproteinemias, angioneurotic edema.

In conditions, such as exophthalmos, orbital pseudotumors because of obstruction to flow of venous blood.

Discoloration

Reddish discoloration seen in subconjunctival hemorrhage also called ecchymosis.

Causes: Trauma, hemorrhagic conjunctivits caused by pneumococci, bleeding disorders…. **(Fig. 2.47)**

Follicles and papillae

Follicles are aggregation of lymphocytes which present as elevated lesions with pale centers, seen in follicular conjunctivits, trachoma…

Papillae represent blood vessels surrounded by inflammatory cells which present as flat lesions with hyperemic center, seen in allergic conjunctivitis **(Fig. 2.48)**.

Pterygium and pinguecula

Common degenerative conditions of conjunctiva described under pterygium.

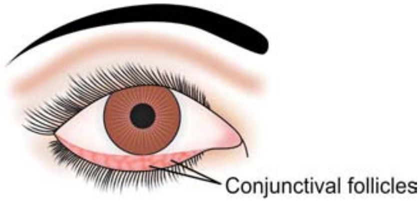
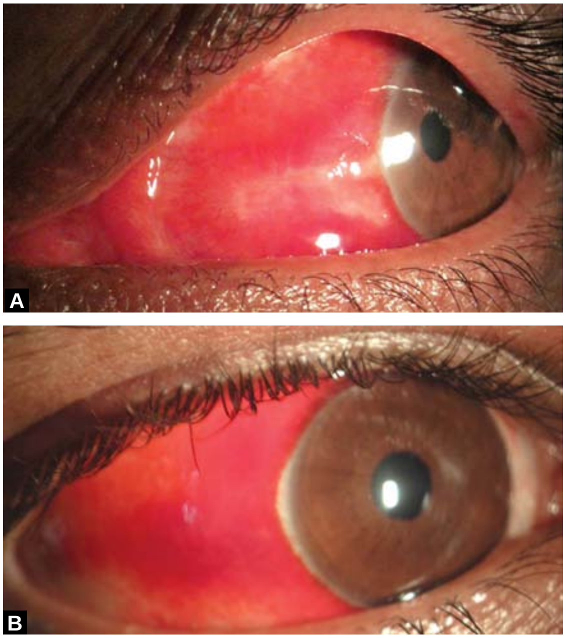


Fig. 2.46: Chemosis



Figs 2.47A and B: Subconjunctival hemorrhage

Conjunctival cysts and tumors: Common conjunctival cysts are cysticercosis cyst, retention cyst…

Common tumors are papilloma, squamous cell carcinoma…

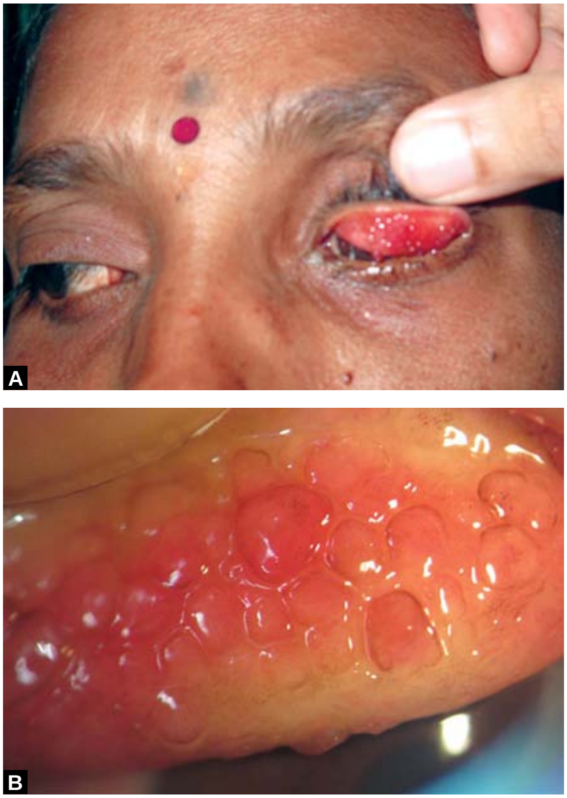
Xerosis of conjunctiva: Characterized by dry, lustreless conjunctiva seen typically in children with vitamin A deficiency.

Bitot's spot: Foamy, silvery white triangular patch situated on bulbar conjunctiva

CORNEA

Cornea has to be examined under the following headings:

- Size
- Shape
- Surface
- Sheen
- Sensations
- Transparency.



Figs 2.48A and B: Examination of upper palpebral conjunctiva by eversion of the upper eyelid—showing papillae

Size: The anterior surface of cornea has a horizontal diameter of 11.7 mm and vertical diameter of 11 mm.

Abnormalities of size of cornea

Microcornea: Anterior horizontal diameter is less 10 mm.

Inheritance is autosomal dominant or recessive

Microcornea can be associated with either micro-ophthalmos-abnormal small eyeball or nanophthalmos-normal small eyeball or it can be isolated anomaly.

Systemic associations: Dwarfism, Fetal alcohol syndrome.

Macrocornea (Megalocornea): Anterior horizontal diameter of cornea is 13 mm or more after 2 years of age or of adult size at birth, i.e.11.7 mm.

Inheritance is sex linked recessive hence more commonly seen in males.

Systemic associations: Connective tissue disorders like Marfan's syndrome, Ehlers-Danlos syndrome and Down's syndrome.

Megalocornea has to be differentiated from buphthalmos-whole eyeball is enlarged as a result of raised IOP in congenital glaucoma.

Keratoglobus-thinning and protrusion of cornea with normal diameter.

How to measure corneal size?

Corneal size is measured with calipers.

It is not measured routinely unless some abnormality is suspected. Corneal size has to be measured in all cases of congenital glaucomas to differentiate buphthalmos from megalocornea.

Shape (Curvature)

Normally cornea is a concavo-convex transparent structure resembling a watch glass with radius of curvature in the optical zone 7.8 mm anteriorly and 7 mm posteriorly. Normal corneal curvature is 44 D.

Abnormalities of corneal shape:

Increased corneal curvature

- Keratoconus-cone shaped protrusion of cornea
- Keratoglobus-thinning and protrusion of whole of cornea.

Decreased corneal curvature

- Cornea plana.

How to measure corneal curvature?

Corneal curvature is measured by:

- Keratometry
- Video keratography
- Computerized topography
- Orbscan

It is not measured routinely unless some abnormality is suspected **(Figs 2.51 to 2.53)**.

Examination of Cornea

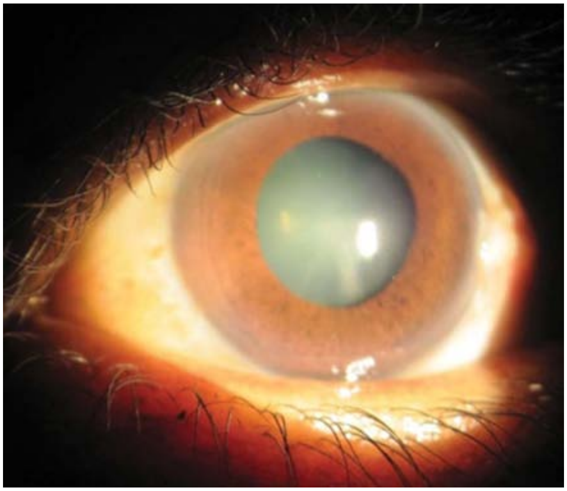


Fig. 2.49: Examination of cornea under diffuse light

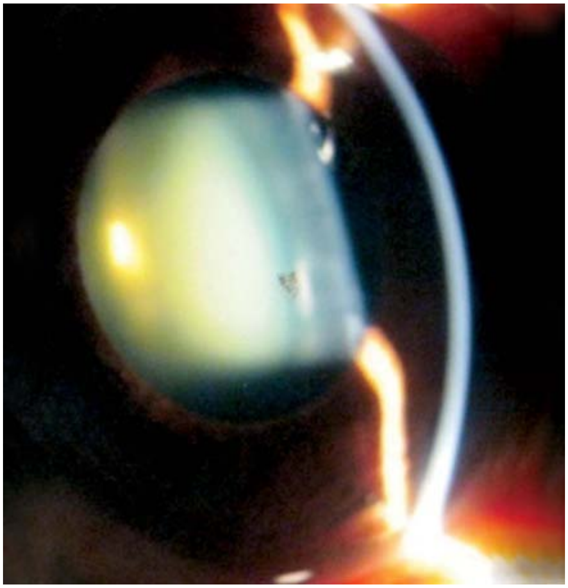


Fig. 2.50: Examination of cornea under slit-lamp to study each layer in detail

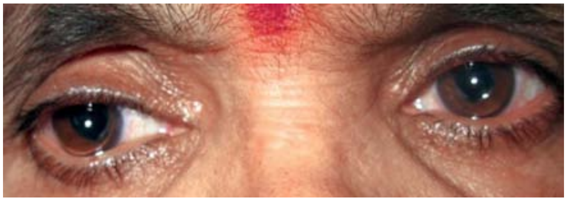


Fig. 2.51: Keratoconus of both eyes. *Note:* Conical protrusion of cornea of both eyes

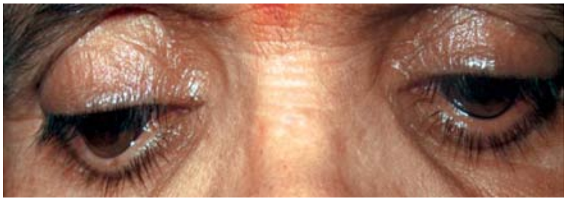


Fig. 2.52: Munson's sign in a patient with severe keratoconus. *Note:* Sagging of lower eyelids on down gaze

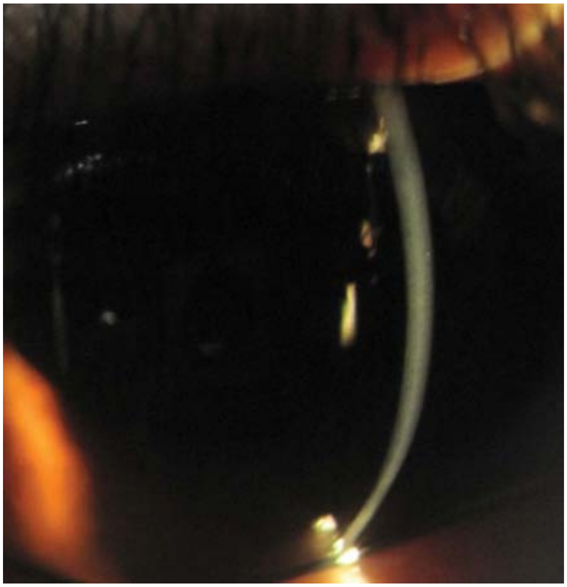


Fig. 2.53: Slit-lamp examination of keratoconus. *Note:* Thinning of cornea inferiorly and conical protrusion of thinned cornea

Surface

Normal corneal surface is smooth.

Smoothness of corneal surface is lost in corneal epithelial defects, abrasions, corneal ulcers and corneal opacity.

How to examine for corneal surface?

Window reflex test: Subject is asked to stand infront of a window with bright light from outside, examiner looks for the reflection of the image of the bars of the window.

This can also be done by looking for the reflection of the image of the torch light.

Irregular corneal surface makes the reflected image distorted.

Placido's disk test: Placido's disk consists of alternating black and white circles with a hole in the center, the examiner looks through the hole and looks for the reflection of the alternate white and black circles on the patient's/subject's cornea. Irregular corneal surface makes the reflected image distorted **(Figs 2.54 to 2.56)**.

Sheen: Shining of cornea is called sheen. Normally cornea has a shining surface.

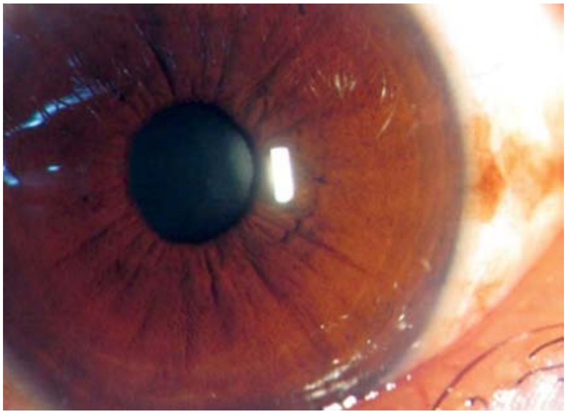


Fig. 2.54: Window reflex for surface and sheen of cornea

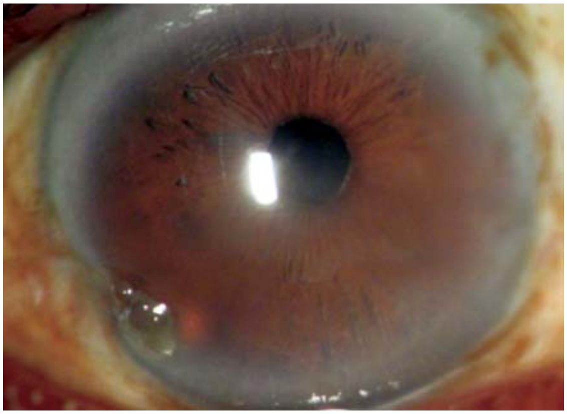


Fig. 2.55: *Note:* Distorted window reflex sheen of cornea in a patient with corneal edema because of corneal degeneration

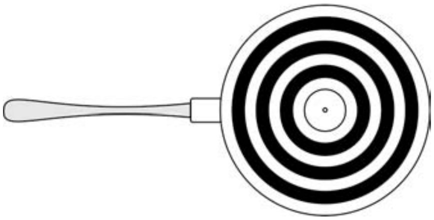


Fig. 2.56: Placido's disk

Sheen of cornea is lost in dry eye, corneal opacity….

How to look for sheen of cornea?

Placido's disk or window reflex test is done to look for sheen of cornea.

The test is done in the similar way as described above to look for surface. Sharpness of the image is lost in conditions where sheen of cornea is altered.

Sensation: Normally, cornea is very sensitive.

Diminished corneal sensation

Congenital: Congenital trigeminal anesthesia, congenital corneal hypoesthesia

Pharmacological: Local anesthetics like xylocaine

Pathological:

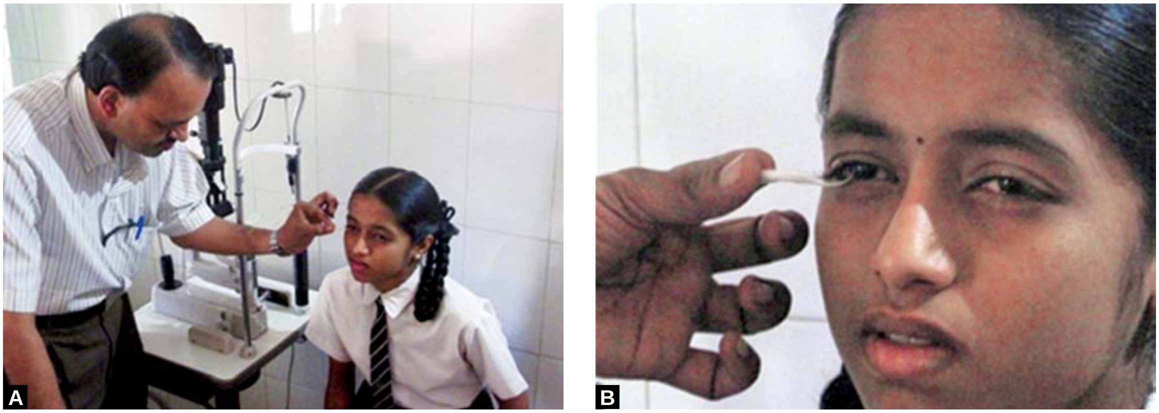
Ocular: Viral infections of cornea like herpes simplex, corneal degenerations and dystrophies.

Post-trauma/surgical corneal scars, keratoplasty, refractive surgery....

Systemic: Leprosy, diabetes **(Figs 2.57A and B)**.

How to look for corneal sensation?

The patient is asked to look straight ahead keeping the eyes wide open; the examiner should touch the corneal surface with dry sterilized cotton and should look for



Figs 2.57A and B: Testing for corneal sensation—the patient/subject is asked to look straight ahead keeping the eyes wide open; the examiner touches the corneal surface with dry sterilized cotton

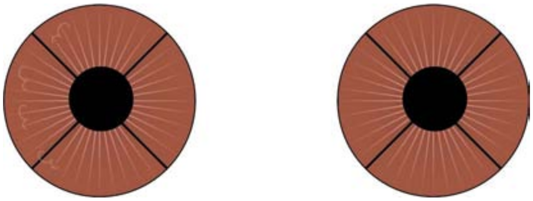


Fig. 2.58: Five quadrants for checking corneal sensation

- Blinking response
- Ask the patient if he/she can feel the touch of the cotton. The quantitative evaluation of corneal sensitivity can be made from aesthesiometer.

Corneal sensation has to be looked in central and four peripheral quadrants (five in total) and should be compared with the other eye at similar locations **(Fig. 2.58)**.

How to look for corneal sensation in patients with reduced/absent blinking rate?

The test is done in similar way; instead of blinking response Bell's phenomenon is noted.

Transparency: Normally cornea is transparent, i.e. structures inside can be made out clearly.

Why cornea is transparent?

Cornea is transparent because of:

- Peculiar arrangement of corneal lamellae (Lattice theory of Maurice)
- Avascularity
- Relative state of dehydration
- Corneal transparency is lost in corneal edema, corneal ulcer, corneal opacity, corneal degeneration, corneal dystrophies….

SCLERA

Normally sclera is white in color and is covered by the bulbar conjunctiva.

Abnormalities of sclera

Discoloration:

Yellowish discoloration is seen in Jaundice blue sclera which is due to thining is seen in

- Osteogenesis imperfecta
- Marfan's syndrome
- Ehlers Danlos syndrome
- High myopia
- Buphthalmos

Staphyloma: Protrusion of thin and weak sclera lined by uveal tissue.

Scleral inflammation: Characterized by sectoral congestion seen in episcleritis and scleritis.

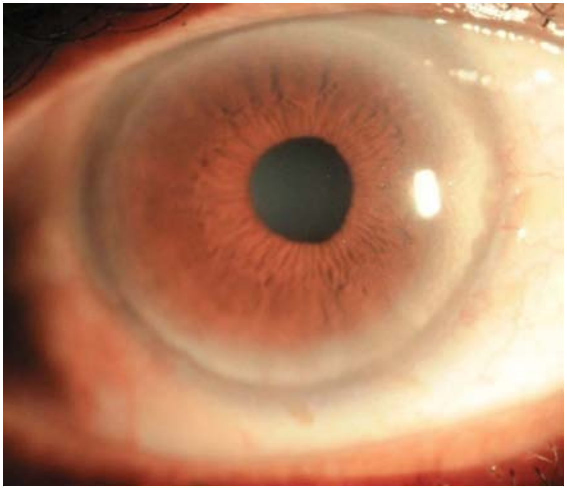


Fig. 2.59: Arcus senilis

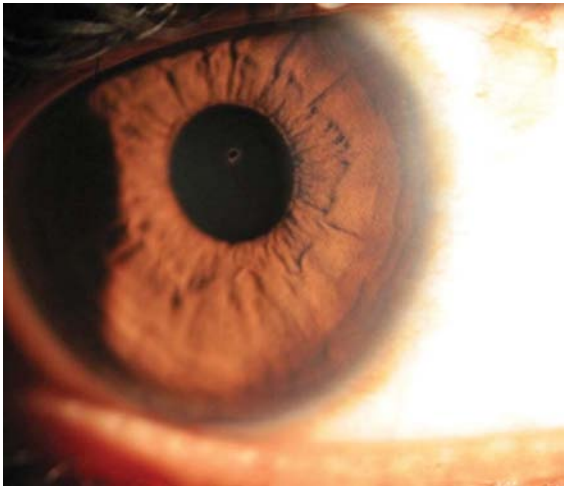


Fig. 2.60: Corneal foreign body

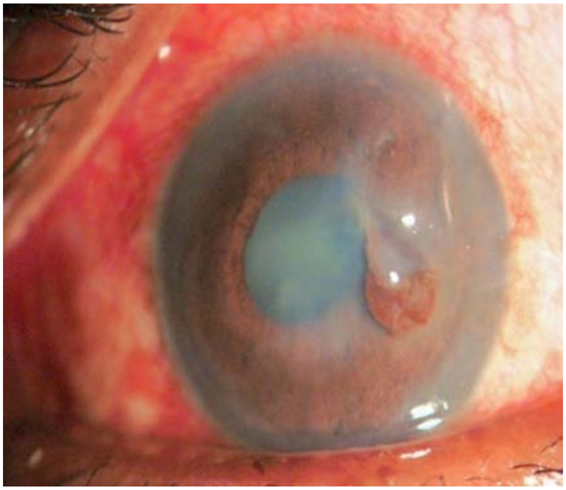


Fig. 2.61: Corneal tear with iris prolapse

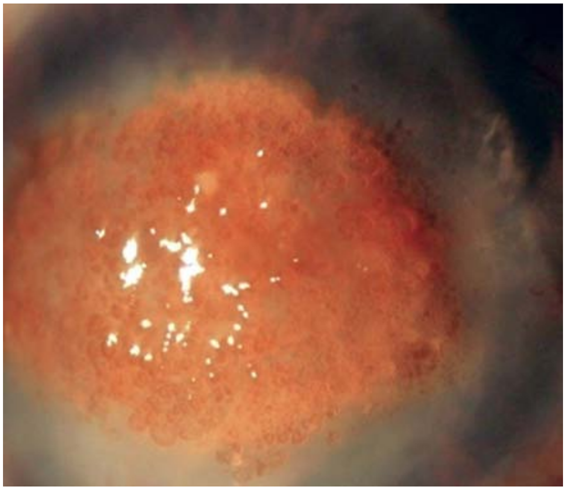


Fig. 2.62: Spheroidal degeneration of cornea. *Note:* The presence of amber colored granules

ANTERIOR CHAMBER

Anterior chamber is examined for

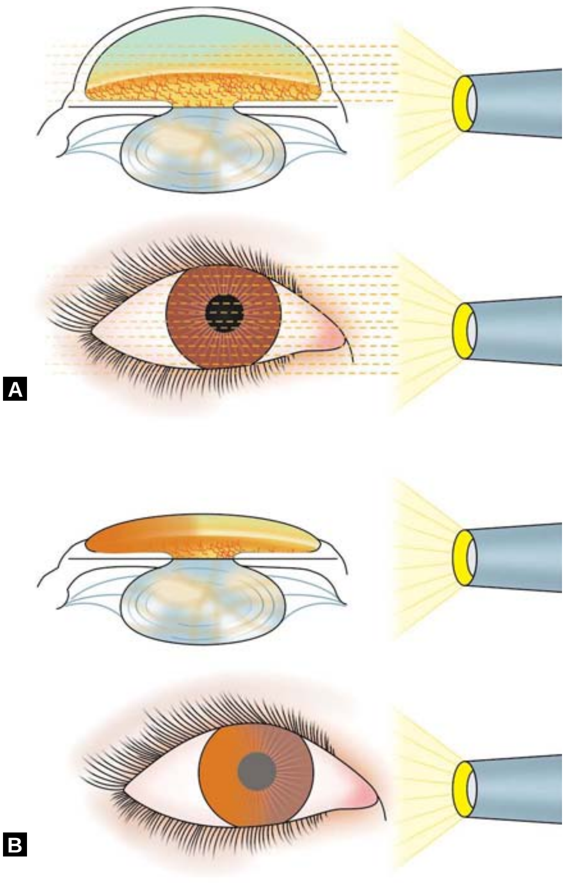
- Depth
- Contents

Normally anterior chamber is about 2.5 mm deep in center and it contains aqueous humor which is transparent in nature.

Abnormalities in the depth of anterior chamber

Shallow anterior chamber:

- Hypermetropia
- Narrow angle glaucoma
- Intumescent cataract
- Phacomorphic glaucoma
- Malignant glaucoma
- Postoperative shallow anterior chamber because of wound leak.



Figs 2.63A and B: (A) Narrow/deep anterior chamber light reaching opposite limbus; (B) Shallow anerior chamber, light not reaching opposite limbus. eclipse sign-positive

Deep anterior chamber:
- Keratoconus
- Keratoglobus
- Buphthalmos
- Aphakia
- Myopia.

Irregular depth anterior chamber:
- Adherent leucoma
- Annular synechiae leading to iris bombe.

How to assess anterior chamber depth?

central anterior chamber can be estimated by

Torch light method:

Light is thrown from temporal side of limbus, if the illumination is seen at the nasal limbus anterior chamber is said to be normal in depth or not shallow. In case of shallow anterior chamber illumination will not reach the nasal limbus and nasal half of the iris appears dark as it is not illuminated, this is called eclipse sign.

This method can determine whether depth of anterior chamber is shallow or not, but it cannot determine whether it is normal or deep.

Other methods of assessing central anterior chamber depth:

Pachymetry by using Haag-Streit optical pachymeter.

Ultrasound pachymetry-Ascan

UBM (Ultrasound biomicroscopy).

Peripheral anterior chamber depth is estimated by *Slit-lamp method: Van Herick slit lamp grading.*

A narrow slit beam is aligned vertically to the peripheral cornea; the thickness of the optical section of cornea (CT) is compared with the distance between corneal endothelium and iris (PAC).

PAC = peripheral anterior chamber depth.

CT = Corneal thickness.

PAC>1/2CT deep peripheral anterior chamber.

PAC=1/4 to ½ CT mild narrow peripheral anterior chamber.

PAC=1/4CT moderate narrow peripheral anterior chamber.

PAC<1/4 CT severely narrow peripheral anterior chamber **(Figs. 2.64 and 2.65)**.

Abnormal contents of anterior chamber

Hyphema: Collection of blood in anterior chamber

Causes: Ocular trauma (mechanical or surgical trauma), hemorrhagic uveitis as in gonococcal iridocyclitis....

Hypopyon: *Collection of pus in the anterior chamber.*

Causes: Corneal ulcer, endophthalmitis, iridocyclitis, panophthalmitis...

Pseudohypopyon: Collection of tumor cells resembling hypopyon in the anterior chamber.

Causes: Ocular tumors like retinoblastoma, malignant melanoma.

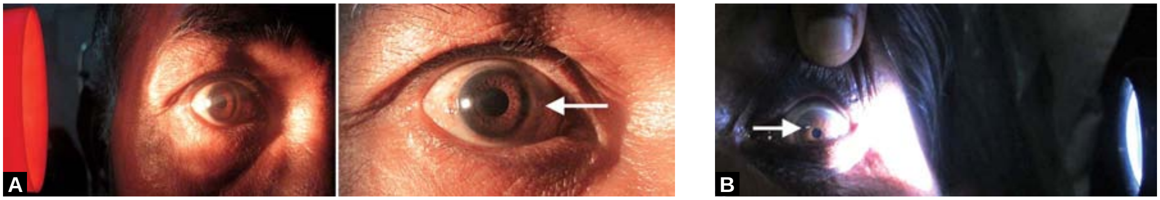
Aqueous flare: Collection of protein particles due to leakage from damaged blood vessels in the anterior chamber.

Causes: Seen in iridocyclitis.

It is demonstrated with slit lamp set at maximum intensity and magnification with beam width 1 mm and beam length 1 mm.

In the beam of light protein particles are seen as moving dust particles. This is based on brownian movements (tyndall phenomenon). The flare is graded as:

Examination of Anterior Chamber and Iris



Figs 2.64A and B: Examination of anterior chamber and iris. Estimation of anterior chamber depth by torch light method. Light is thrown from temporal side of limbus and to look for illumination at the nasal limbus. (A) Illumination is seen at the nasal limbus hence anterior chamber is said to be normal in depth or not shallow; (B) The illumination is not seen at the nasal limbus, hence anterior chamber is shallow

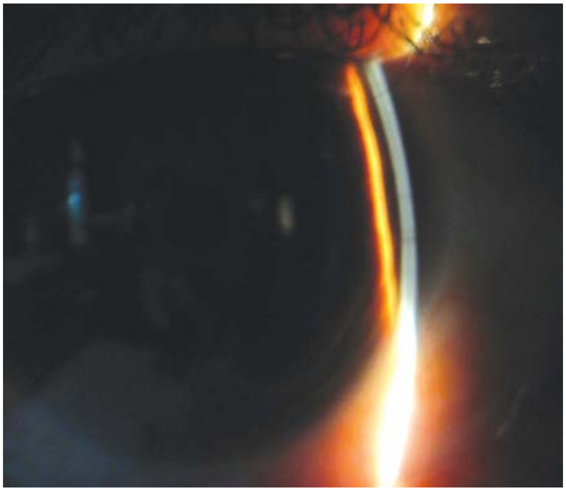


Fig. 2.65: van Herick slit-lamp grading

A narrow slit beam is aligned vertically to the peripheral cornea by comparing the thickness of the optical section of cornea with the distance between corneal endothelium and iris anterior chamber depth is graded

+ faint, just detectable flare

++ moderate flare, iris and lens details clear

+++ marked flare, iris and lens details not clear

++++ intense flare with fixed coagulated aqueous with fibrin.

Aqueous cells: Collection of inflammatory cells.

Causes: Seen in iridocyclitis.

It is demonstrated with slit lamp set at maximum intensity and magnification with beam width 1 mm and beam length 1 mm. The cells are counted and graded as

Cells per fileld	Grade
0	–
1–10	+
11–20	++
21–50	+++
> 50	++++

Inverse hypopyon: Collection of silicone oil in the anterior chamber.

Since silicone oil is lighter than water, emulsified silicone oil collects in the anterior chamber superiorly. Silicone oil is used as vitreous substitute in retinal surgeries like RD surgery.

Other abnormal things seen are anterior chamber IOL, anteriorly dislocated lens…

Angle of anterior chamber

Angle of anterior chamber cannot be viewed directly with slit lamp because of

- Overhanging scleral shelf
- Total internal reflection of light from the angle of the anterior chamber (as the angle of incidence of these rays is greater than the critical angle of cornea-air interface (46 degrees)).
- *Gonioscopy:* Clinical technique of examination of angle of anterior chamber using gonioscope.

Gonioscopy is done in examination of patients with glaucoma.

IRIS

Iris has to be examined for color, pattern and abnormalities.

Color

Color of iris varies in different races. It is dark brown in orientals.

Heterochromia iridium: Iris color of two eyes is different.

Causes:

Hypochromic heterochromia: Here the lighter colored iris is abnormal. It is seen in Horner's syndrome, Fuch's heterochromic iridocyclitis, Iris atrophy following trauma or iridocyclitis.

Hyperchromic heterochromia: Here the darker colored iris is abnormal. It is seen in malignant melanoma of iris, siderosis bulbi...

Heterochromia iridis: Iris color of same eye is different in different sectors.

Causes: It may be congenital or acquired following Iiris atrophy seen after an acute attack of angle closure glaucoma or iridocyclitis.

Pattern

Normally iris has a specific pattern because of crypts, ridges and collarette. This pattern is disturbed or absent in atrophic patches which are seen in old iridocyclitis **(Figs 2.66 to 2.68)**.

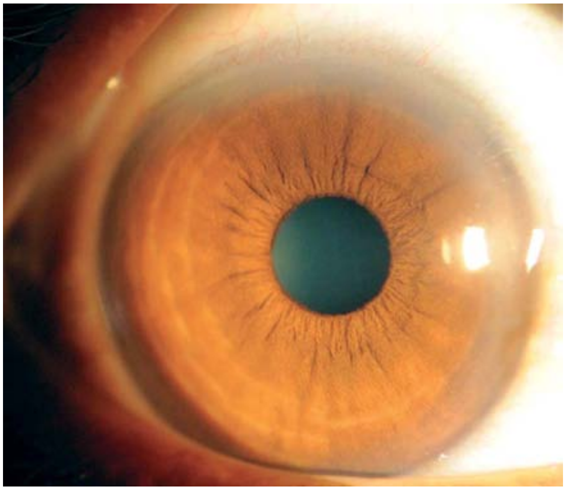


Fig. 2.66: Normal color and pattern of iris. *Note:* The pattern of iris because of presence of collarette, crypts and radial straitions on the anterior surface of iris

Abnormalities

Iridodonesis: It is tremulousness of iris seen in aphakia due to lack of posterior support which is normally given by lens.

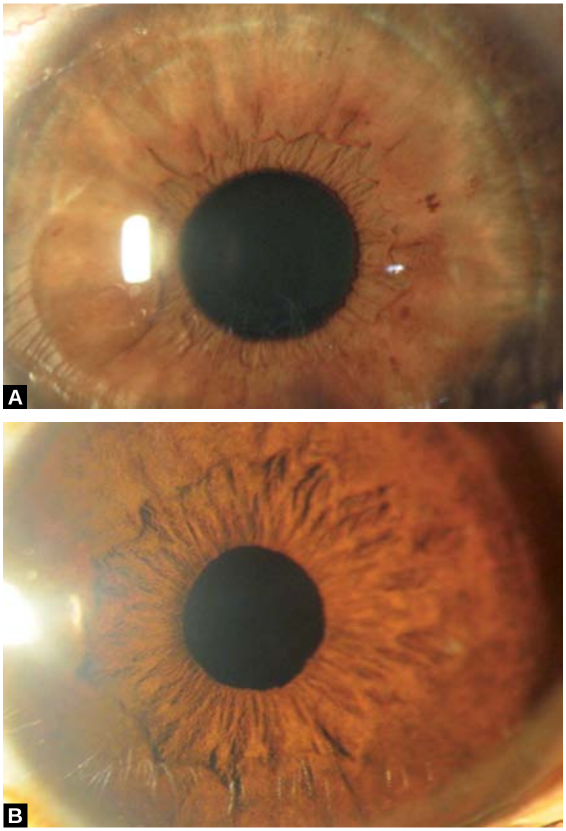
Synechiae: Adhesion of iris to other intraocular structures are called synechiae.

- Anterior synechiae-adhesion of iris to structures infront of it like corneal endothelium
- Peripheral anterior synechiae-adhesion of iris root to trabecular meshwork. this is made out only on gonioscopy and it is seen in angle closure glaucoma.
- Posterior synechiae-adhesion of iris to lens. Posterior synechiae can be
  - Total posterior synechiae
  - Segmental posterior synechiae.

Pseudoexfoliation

Small flakes seen on the pupillary margin indicate pseudoexfoliation.

There is a strong relation between glaucoma and pseudoexfoliation. Hence all patients



Figs 2.67A and B: Normal variations in color of the iris light brown and dark brown color

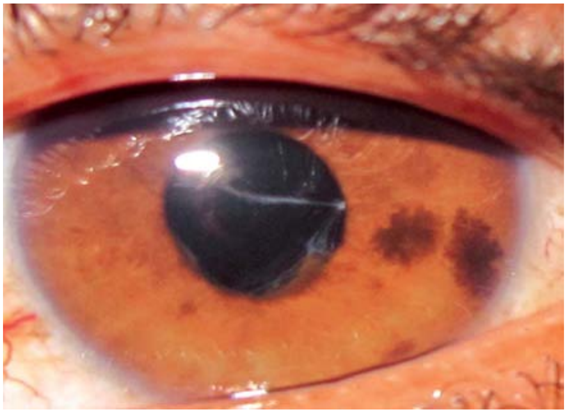


Fig. 2.68: Naevi of iris. *Note:* Dark pigmented spots on iris which are relatively common finding

with pseudoexfoliation should be screened for glaucoma.

True exfoliation is seen in glass blowers because of exposure to heat.

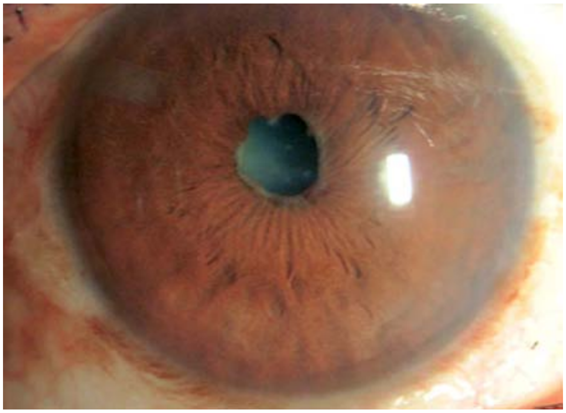


Fig. 2.69: Segmental posterior synechiae,a sequelae of iridocyclitis. *Note:* The adhesions of iris at some points to underlying lens leading to Festooned pupil because of patchy dilatation in response to mydriatic agents

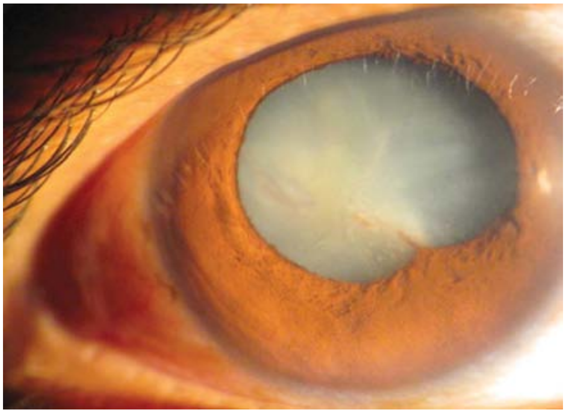


Fig. 2.70: Cataract with posterior synechiae following trauma. *Note:* The adhesion between iris and anterior capsule of lens

Persistent Pupillary Membrane

It is remnant of vascular sheeth of lens seen as tags on the surface of iris.

Rubeosis Iridis

New vessel formation on iris seen in central retinal vein occlusion, diabetes mellitus, Fuch's heterochromic iridocyclitis, Anterior segment ischemia, carotid artery occlusive disease, neovascular glaucoma....

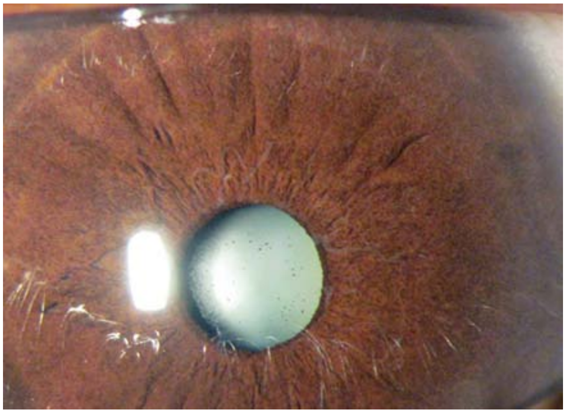


Fig. 2.71: Atrophy of iris. *Note:* Disturbance in the pattern of iris in patient with old healed iridocyclitis

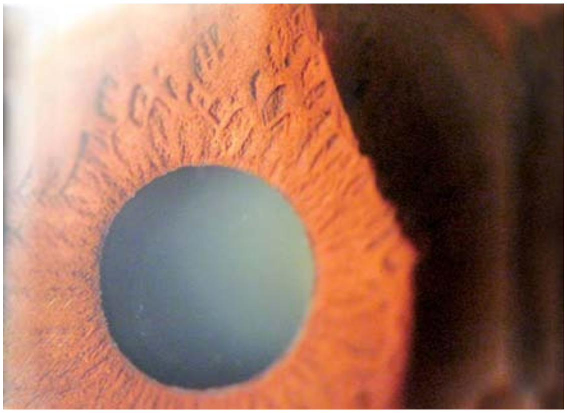


Fig. 2.72: Pseudoexfoliation of iris. *Note:* The presence of white flakes at the pupillary margin of iris

Coloboma of iris: Coloboma means absence of tis- sue due to failure of closure of embryonic fissure. Coloboma of iris can be typical or typical, complete or incomplete.

- Typical–seen in inferonasal quadrant
- Atypical–seen in other position.

Complete: When it extends from iris to optic nerve, i.e. involving iris, lens, retina, choroid and optic disk.

Incomplete: When it fails to extend from iris to optic nerve.

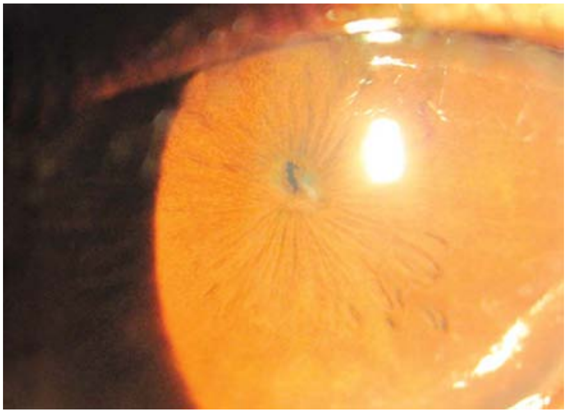


Fig. 2.73: Occlusive pupillae, a sequelae of iridocyclitis.*Note:*The occlusion of pupil completely due to exudates

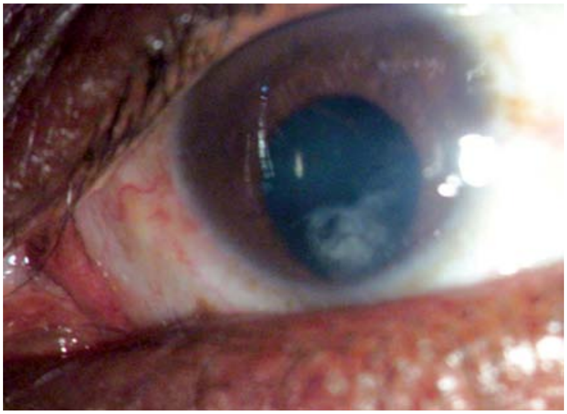


Fig. 2.74: Coloboma of iris. *Note:* The absence of iris tissue in the inferonasal quadrant

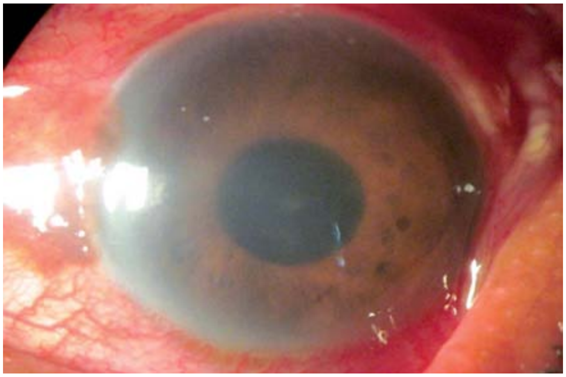


Fig. 2.75: Acute angle closure. *Note:* Circumcorneal congestion, corneal edema, middilated pupil, shallow anterior chamber

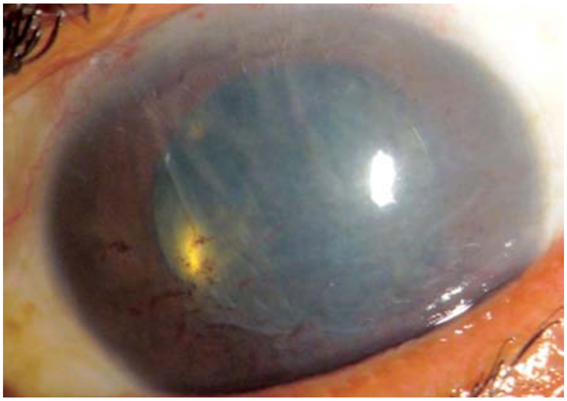


Fig. 2.76: Corneal edema with keratic precipitates over endothelium in a patient with iridocyclitis

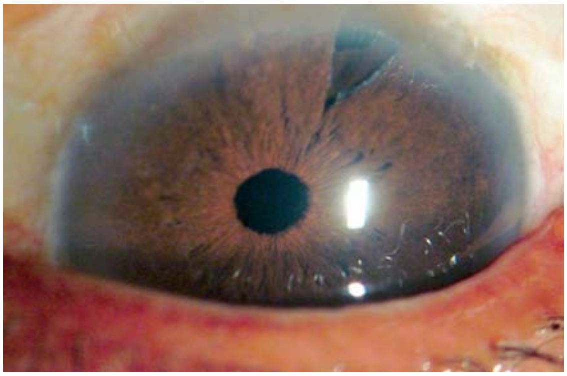


Fig. 2.77: An eye with shallow anterior chamber with prophylactic iridotomy

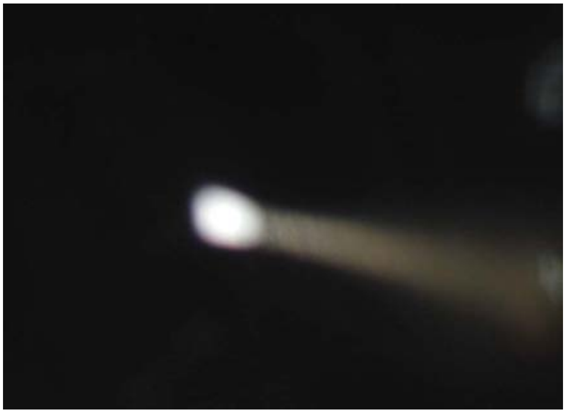


Fig. 2.78: Slit lamp photograph demonstrating anterior chamber flare

PUPIL

Pupil is an aperture in the center of the iris.

Pupil has to be examined under the headings

Number: Normally there is one pupil. Polycoria-congenital presence of more than one pupil.

Site: Normally pupil is placed in the center or slightly nasal. Congenital eccentric pupil is called corectopia.

Size: Normally pupil size is between 3–4 mm.

Shape: Normally pupil is round in shape.

Color: Color depends on the structures behind the pupil, i.e. lens

Normally pupil is black/grayish black in color.

Reflexes/pupillary reactions: Light reflex and near reflex.

Abnormalities in pupil size

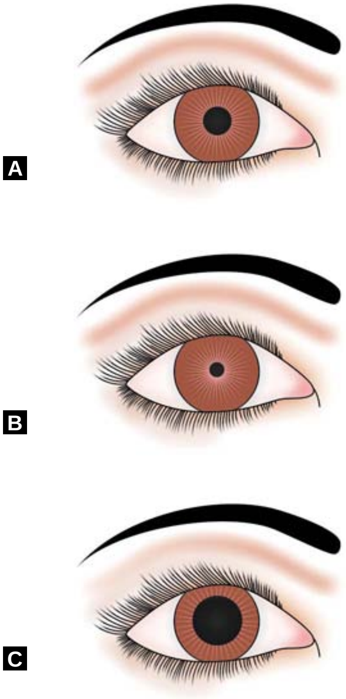
The size of the pupil is mainly because of action of two muscles.

Sphincter pupillae supplied by parasympathetic fibers.

Dilator pupillae supplied by sympathetic fibers.

Abnormally small pupil-Miosis.

Abnormally large pupil-Mydriasis.



Figs 2.79A to C: (A) Normal pupil 2–4 mm in diameter; (B) Miotic pupil <1 mm in diameter; (C) Mydriatic pupil >6 mm in diameter

Causes of miosis

Physiological: Old age (senile rigid pupil), during sleep, exposure to bright light.

Pharmacological: Effect of parasympathomimetic drugs like pilocarpine, systemic morphine.

Pathological: Pontine hemorrhage, Horner's syndrome.

Causes of mydriasis

Physiological: Exposure to dim light.

Pharmacological: Parasympatholytic drugs like atropine, homatropine, cyclopentolate, tropicamide and sympathomimetic drugs like phenylephrine.

Pathological: Optic atrophy, absolute glaucoma,third nerve paralysis, total retinal detachment…

Abnormalities in pupil shape

Normally pupil is round in shape. Shape becomes irregular due to synechiae in cases of iridocyclitis.

Festooned pupil: irregular dilated pupil seen after effect of mydriatics in presence of posterior synechiae.

Abnormalities in color of pupil

- Normally color of pupil is black/grayish black
- Grayish white-immature cataract
- Pearly white-mature cataract
- Milky white-hypermature cataract
- Jet black-aphakia
- Jet black with shining reflexes-pseudophakia
- Yellowish white mid dilated nonreacting pupil–amaurotic cat's eye (seen in retinoblastoma, retrolental fibroplasias, toxocara endophthalmitis…)

How to look for pupillary reactions?

Direct light reflex:

Patient is seated in dimly illuminated room, two eyes are separated by palm of the hand or a cardboard and light is thrown on one eye while observing for constriction of pupil. Other eye is tested in the same way.

Normally pupil constricts on exposure to light.

Indirect light reflex/consensual light reflex:

Patient is seated in dimly illuminated room, two eyes are separated by palm of the hand or a cardboard and light is thrown on one eye observing for constriction of pupil in the other eye. Other eye is tested in the same way.

Normally contralateral pupil also constricts when light is thrown on one eye.

Near reflex:

Patient/Subject is asked to look at far object and then asked to see finger tip held at 15 cms from eye observing for constriction of pupil and convergence.

Normally on looking at nearby objects pupils constrict and eyes converge.

Pathway of Light Reflex

- *Afferent:* Optic nerve
- *Center:* Edinger Westphal nucleus
- *Efferent:* Oculomotor nerve.

Afferent fibers start from rods and cones in retina and travel along optic nerve and optic chiasma. In optic chiasma nasal fibers decussate and travel along the opposite optic tract and temporal fibers travel along the same optic tract to end in pretectal nucleus.

Edinger Westphal nucleus receives fibers from both pretectal nuclei.

Efferent fibers consists of parasympathetic fibers arising from E-W nucleus and travel along the oculomotor nerve to reach the ciliary ganglion. Postganglionic fibers travel along the short ciliary nerves and reach sphincter pupillae.

Pathway of Near Reflex

Near reflex occurs on looking at a near object.
It consits of two components:

1. Convergence reflex
2. Accomodation reflex

Convergence reflex:

- *Afferent:* Oculomotor nerve
- *Center:* Edinger Westphal nucleus
- *Efferent:* Optic nerve.

Afferent fibers travel along the oculomotor nerve from medial recti to a presumptive convergence center in pretectal region and then to the center, E-W nucleus.

Efferent fibers arise from E-W nucleus travel along the oculomotor nerve to accessory ciliary ganglion. Postganglionic fibers innervate the sphincter pupillae.

Accommodation reflex:

- *Afferent:* Optic nerve
- *Center:* Edinger Westphal nucleus
- *Efferent:* Oculomotor nerve.

Afferent fibers from retina travel along optic nerve, optic chiasma, optic tract, lateral geniculate body, optic radiations and striate cortex to reach parastriate cortex.

From the parastriate cortex the fibers reach E-W nucleus through the occipito-mesencephalic tract.

Efferent fibers travel along oculomotor nerve to reach the sphincter pupillae and ciliary muscle.

Abnormalities of Pupillary Reflexes

Amaurotic Pupil or Total Afferent Pathway Defect

Absence of direct light reflex on affected side and absence of consensual reflex on normal side. This is seen in lesions of optic nerve or retina on the affected side leading to complete blindness.

Marcus Gunn Pupil or Relative Afferent Pathway Defect

Paradoxical response of the pupil to light in the presence of a relative afferent pathway defect. Pupils of both eyes dilate on stimulation of diseased eye and both constrict on stimulation of normal eye. This is seen in incomplete optic nerve lesions. It is tested by swinging flash light test.

Swinging flash light test **(*Fig. 2.80*)**
A light source is alternatively directed from one eye to the other. First light is directed to normal eye and it results in constriction of both pupils and then light is directed to affected eye which results in dilatation of both pupils.This paradoxical dilatation of pupil is called Marcus gunn pupil.

Wernicke's Hemianopic Pupil

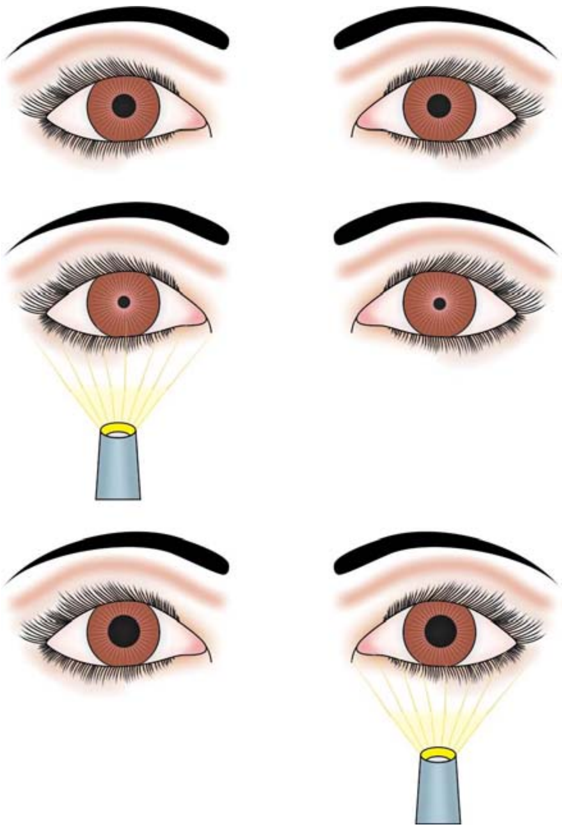
Light reflex is absent when light is thrown on the temporal half of retina of the affected side and nasal half of normal side and vice versa, i.e. light reflex is present when light is thrown on the nasal half of the affected side and temporal half of normal side. It is seen in lesions of the optic tract.

Efferent Pupillary Defects

Adie's Tonic Pupil

Pupil that reacts poorly to light and normally to accommodation. It is seen in parasympathetic denervation as a result of damage to ciliary ganglion.

The affected pupil is dilated but constricts rapidly with 0.125 percent pilocarpine because of denervation supersensitivity.



On stimulating normal eye (RE), pupils of both eyes constrict
On stimulating eye with RAPD (LE), pupils of both eyes dilate

Fig. 2.80: Swinging flash light test

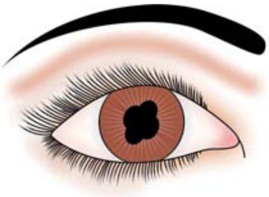


Fig. 2.81: Festooned pupil

Pupillary Light Near Dissociation

Argyll Robertson Pupil (ARP-Accommodation Reflex Present)

It is a bilateral condition characterized by absence of light reflex with retention of accommodation reflex.

It is caused by lesions involving pretectal like neurosyphilis and other diseases like multiple sclerosis, tumors...

Horner's Syndrome

It results from damage to sympathetic innervation to eye.

Features of Horner's syndrome are:

- Ptosis because of paralysis of Muller's muscle of upper eyelid
- Inverse ptosis, i.e. elevation of lower eyelid, because of paralysis of Muller's muscle in lower eyelid
- Miosis due to paralysis of dilator pupillae.

Absence of sweating on the affected side of the face, enophthalmos are the other features seen.

Hutchinson's Pupil

Seen in head injury due to raised intracranial pressure.

Stage I: Ipsilateral constriction of pupil.

Stage II: Dilatation of pupil with no light reflex.

Stage III: Bilateral dilatation of both pupils.

LENS

Lens is a transparent biconvex structure placed in the patellar fossa suspended by the suspensory ligaments of the ciliary processes.

Lens has to examined under the headings.

Position: Normally lens is biconvex structure with anterior surface less curved than posterior surface.

Shape: Normally lens is biconvex structure with anterior surface less curved than posterior surface.

Color: Normal color of the lens is grayish black/black.

Transparency: Normal lens is transparent structure.

Abnormalities in position

Displacement of lens from its normal position.

Displacement of lens can be subluxation or dislocation.

Causes:

- Congenital simple ectopia lentis
- Ectopia lentis with systemic anomalies like Marfan's syndrome (typically lens is displaced upwards and outwards), homocystinuria (typically displacement is downwards and inwards), Weil-Marchesani syndrome, Ehlers-Danlos syndrome…
- Trauma
- Hypermature cataract.

Subluxation: Partial displacement of the lens from its normal position.

Subluxation shows

- Edge of the lens is seen after dilatation of the pupil
- Iridodonesis
- Unilateral diplopia (seen when part of the pupil is phakic and part aphakic).

Dislocation: Complete displacement of lens from its normal position.

In anterior dislocation lens is seen in the anterior chamber.

In posterior dislocation lens is present in vitreous cavity with clinical features of aphakia **(Figs 2.82 and 2.83)**.

Abnormalities in shape

Lenticonus: Cone shaped bulge seen on anterior or posterior capsule respectively called as anterior lenticonus and posterior lenticonus. Anterior lenticonus is seen in Alport's syndrome.

Spherophakia: Small spherical lens. It is seen in Weill-Marchesani syndrome.

Abnormalities in transparency

Transparency of cornea is lost in cataract.

Abnormalities in color: Same as abnormalities in color of pupil **(Figs 2.84 to 2.89)**.

Purkinje images test

It was described originally to diagnose mature cataract and aphakia.

It is not done frequently in clinical practice as by examination of pupillary color mature cataract and aphakia can be easily diagnosed.

When light is shown on the eye four purkinje images are formed because of four reflecting

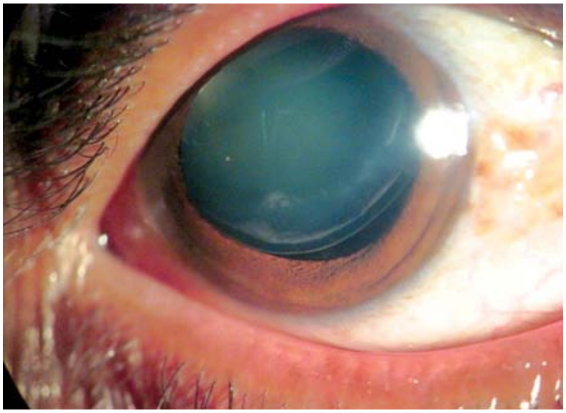


Fig. 2.82: Subluxated lens. *Note:* The inferior lens edge which is seen after dilatation of pupil

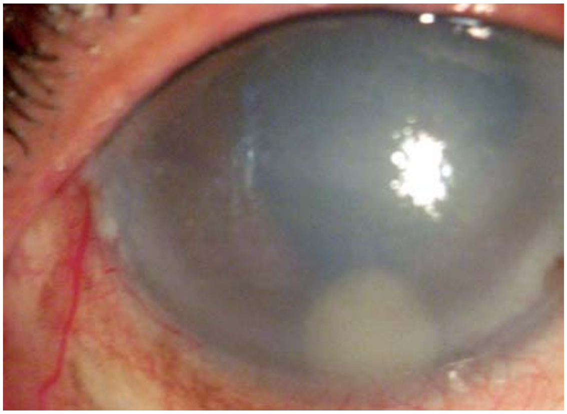


Fig. 2.83: Anterior dislocated lens into anterior chamber. *Note:* The presence of corneal edema with small nucleus of lens in anterior chamber

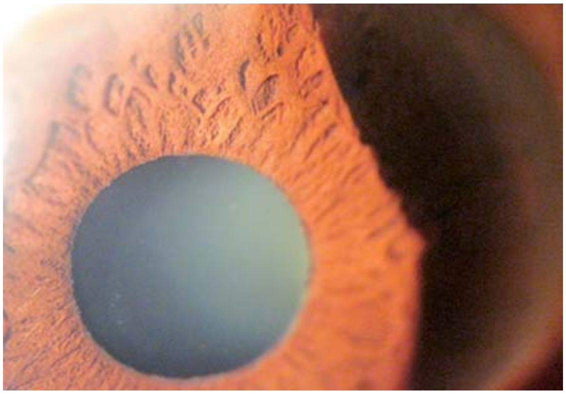


Fig. 2.84: Normal phakic eye. *Note:* The grayish black color of the lens

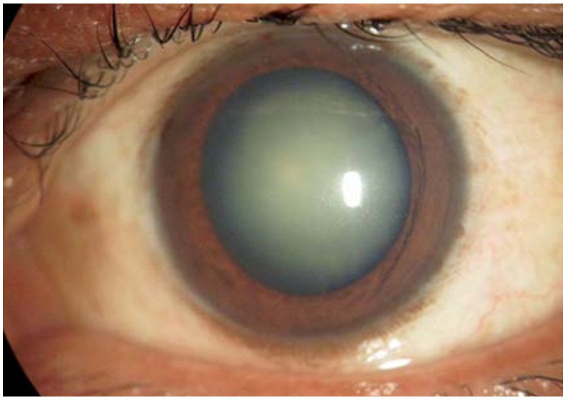


Fig. 2.85: Immature cataract. *Note:* Grayish white color of the lens

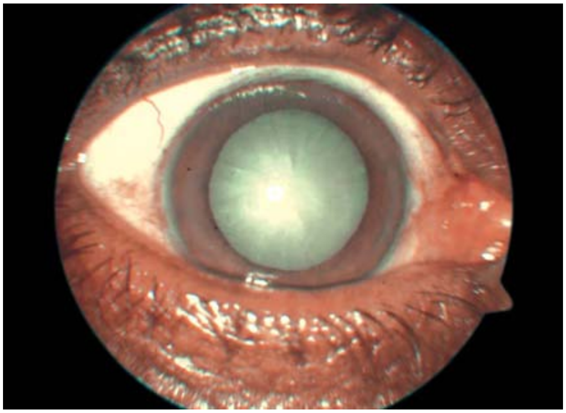


Fig. 2.86: Mature cataract. *Note:* The presence of pearly white color of the lens

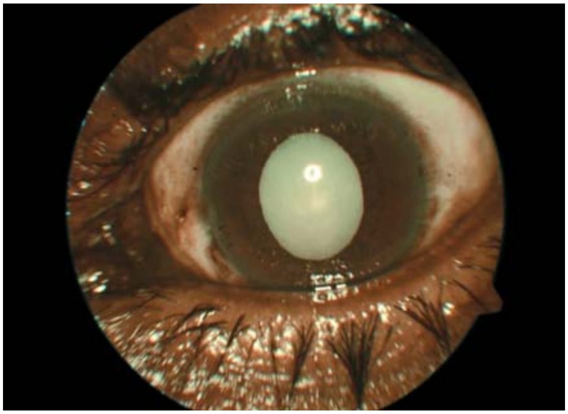
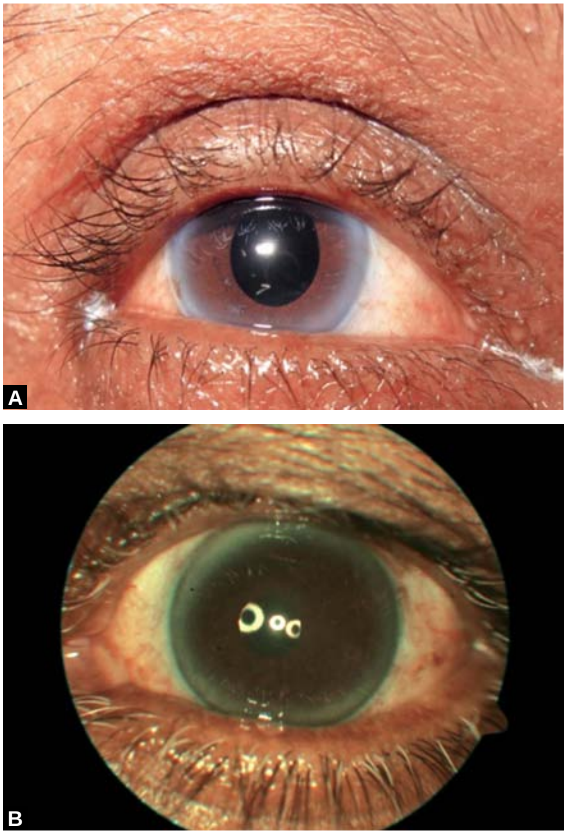
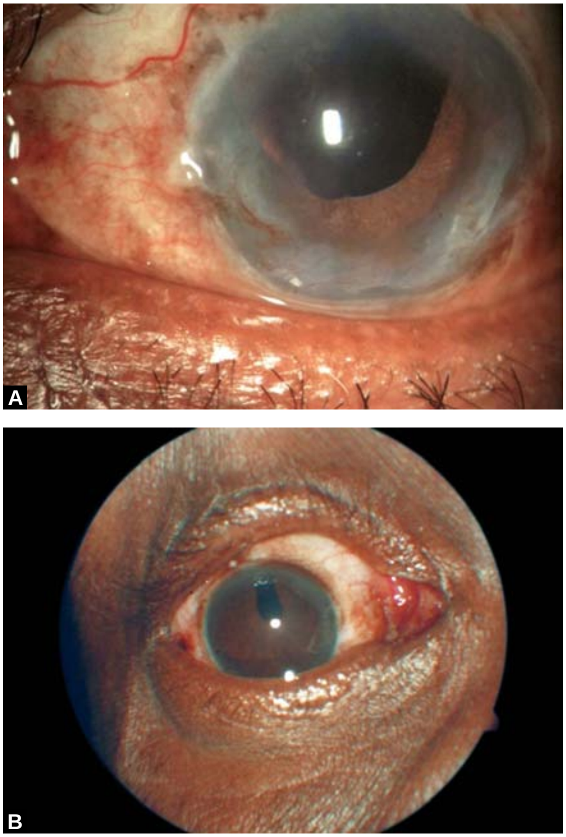


Fig. 2.87: Hypermature cataract. *Note:* The presence of milky white color of the lens



Figs 2.88A and B: Pseudophakia*. Note:* Jet black color of pupil with shining reflexes



Figs 2.89A and B : Aphakia. *Note:* Jet black color of pupil

surfaces, anterior and posterior surfaces of cornea and lens.

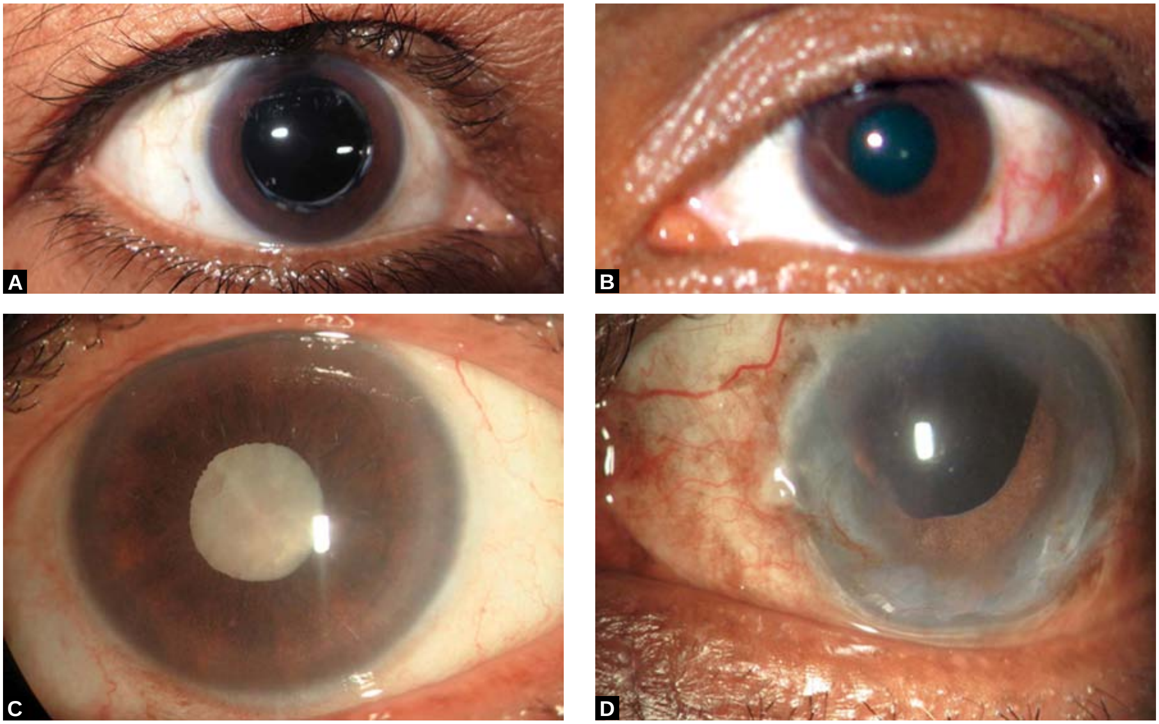
Aphakia—both anterior and posterior surfaces of lens are absent hence both 3rd and 4th images are absent.

Mature cataract—4th image is absent as light cannot reach posterior surface because of complete opacification of lens **(Figs 2.90A to D)**.

How to look for Purkinje's images?

Torch light is thrown on the eye, observing for the reflected image of the torch light on the reflective surfaces of the eye.

Of the four reflective surfaces first three, anterior and posterior corneal surfaces and anterior capsule



Figs 2.90A to D : Purkinje images (A) Pseudophakia with 1st and 4th Purkinje images; (B) Phakic (Normal) with 1st and 4th Purkinje images; (C) Mature cataract with absence of 4th Purkinje image; (D) Aphakia with absence of 4th Purkinje image

of lens are convex, i.e. they act like convex mirror and the fourth reflective surface, posterior lens capsule is concave, i.e. it act like concave mirror. Hence first three purkinje images are virtual and erect (character of image produced by convex mirror) and fourth image is real inverted and minified (character of image produced by concave mirror).

Since first three images are similar to each other it is difficult to appreciate them separately.

The best use of Purkinje images can be made to differentiate immature and mature cataract. In immature cataract forth Purkinje image is present and in mature cataract it is absent.

Purkinje images

All four present—Normal phakic eye, Immature cataract, pseudophakia.

First three are present and fourth is absent-Mature cataract.

First two are present, third and fourth are absent-Aphakia.

FUNDUS: VITREOUS AND RETINA

Fundus examination is done by:

- Ophthalmoscopy (direct or indirect)
- Slit lamp with accessory lenses like +90 D, 78 D, –58.6 D, three mirror or four mirror gonio lens.

Fundus Examination Includes

Media: Normally the media is transparent. It will be hazy in case of opacities in the media like corneal opacity, cataract, vitreous opacity...

Optic disk: Size, shape, margins, color, cup, cup-disk ratio, neuroretinal rim are examined in that order.

Macula: It is examined for abnormalities like macular edema, macular hole, macular scarring, macular degeneration….

Retinal blood vessels and background of the retina: Blood vessels have to be examined for dilatation, narrowing, neovascularization..... Background of the retina has to be examined for superficial and deep hemorrhages, exudates, retinal detachment, pigmentary disturbances, degenerations….

Examination of retina is described in detail in Chapter 11.

CHAPTER

3

CASE PROFORMA

CHAPTER OUTLINE

- History
- General Physical Examination
- Relevant Systemic Examination

HISTORY

1. Biodata:

2. Presenting complaints:

3. History of presenting illness:

4. Ocular history:

5. Past history:

6. Family history:

7. Personal history:

8. Socioeconomic history:

GENERAL PHYSICAL EXAMINATION

Pulse
Blood pressure
Temperature
Respiratory rate

RELEVANT SYSTEMIC EXAMINATION

Ocular Examination

1. **Head posture**

2. **Facial symmetry**

3. **Ocular posture**

4. **Visual acuity**

RIGHT EYE *LEFT EYE*

Distance vision
With naked eye
With pin hole
(if the visual acuity is less than 6/6)
With spectacles
(if the patient is wearing spectacles)

Near vision

5. **Eyebrows**
Position

Texture of cilia

6. **Eyelids**
Position

Margins

Movements

Palpebral aperture width

Skin over the eyelids

7. **Lacrimal apparatus**
Lacrimal puncta

Skin over lacrimal sac area

Regurgitation test

8. **Eyeball**
   Size

   Position

   Movements of eyeball

   Uniocular movements

   Binocular movements

9. **Conjunctiva**
   Palpebral conjunctiva

   Bulbar conjunctiva

   Conjunctival fornices

10. **Cornea**
    Size

    Shape

    Surface

    Sheen

    Sensations

    Transparency

11. **Sclera**

12. **Anterior chamber**
    Depth

    Contents

13. **Iris**
    Color

    Pattern

14. **Pupil**
    Number

    Site

    Size

    Shape

    Color

    Pupillary reactions

    Direct light reflex

    Indirect light reflex

    Near reflex

15. **Lens**
    Position

    Shape

    Color

    Transparency

16. **Fundus**

17. **Intraocular pressure**

Differential diagnosis:

Provisional diagnosis:

Investigations:

Treatment:

CHAPTER

4

CASE PRESENTATION

CHAPTER OUTLINE

- Cataract
- Pseudophakia
- Aphakia
- Corneal Opacity
- Adult Dacryocystitis
- Chalazion
- Pterygium
- Corneal Ulcer
- Ptosis

CATARACT

1. *Biodata:*
   Here is a male/female patient aged about .... years, ... by occupation, hailing from ....

Important Facts:

Age: Congenital cataract onset at birth.

Developmental cataract onset after birth to puberty.

Presenile cataract onset after puberty before 50 years of age.

Senile cataract onset after 50 years of age.

Occupation: Total amount of annual exposure to sunlight has a direct relation to high incidence of senile cataract seen in the hot and dry areas of the world. Cataract is more common in people of rural origin.

2. *Presenting Complaints:*
   His presenting complaints are
   Diminision of vision in RE/LE/BE since .... months/years.
3. *History of Presenting Illness:*
   He/She was apparently normal .... months/years back. He/She noticed diminision of vision insidious in onset gradually progressive in nature. Initially he/she was able to see things at .... meters, now he/she can see things at .... meters.
   Diminision of vision is (Choose one among three)
   - Same for both near and distance vision
   - More for near vision
   - More for distance vision

   Diminision of vision is (Choose one among three)
   - Same in dim light and bright light
   - More in dim light
   - More in bright light

   Diminision of vision is associated with
   - Glare
   - Pain
   - Redness
   - Watering
   - Discharge
   - Browache
   - Headache

Important facts:

Cuneiform cataract: As the cataract starts at periphery, visual disturbances are noted at a comparatively late stage. As the pupil dilates in dim light these patients experience more diminision of vision in dim light.

Cupuliform cataract: As the cataract starts in the center, visual disturbances are noticed at early stage. As the pupil is constricted in bright light these patients experience more diminision of vision in bright or day light.

Nuclear cataract: In nuclear sclerosis distant vision decreases and near vision improves due to index myopia. Hence such persons will be able to read without presbyopic glasses. This improvement in near vision is called second sight.

Glare is one of the earliest symptoms of cataract and is due to diffraction of light by lenticular opacity. Other earliest symptoms of cataract are colored halos and uniocular polyopia.

Pain, redness, watering, discharge are seen
- In complications associated with cataract like Phacoanaphylactic uveitis, Phacomorphic glaucoma, Phacolytic glaucoma...
- In other ocular diseases like acute dacryocystitis, conjunctivitis.. when present along with cataract.

4. *Ocular history:*
   He/She is/was wearing spectacles for
   - Near vision
   - Distance vision (choose one among three)
   - Both

   He/She gives history of surgery/no history of surgery to RE/LE/BE.
   He/She history of trauma/no history of trauma to RE/LE/BE.
   He/She history of using eyedrops for long duration/no history of using eyedrops to RE/LE/BE.

Important facts:

Posterior subcapsular cataracts are associated with prolonged use of steroids.

Anterior subcapsular cataracts are associated with long-term use of miotics like echothiophate, demecarium chloride.

Amiodarone, chlorpromazine, busulfan are some other drugs associated with development of cataract.

Important facts:

Trauma is associated with

- Vossius ring
- Conclusion cataract
- Rosette cataract
- Subluxation of lens
- Dislocation of the lens

5. *Past history:*

He/She is a known diabetic on treatment/ not a known diabetic.

He/She is a known hypertensive on treatment /not a known hypertensive.

He/She is a known patient of COPD, asthma, Ischemic heart disease on treatment/not a known patient of COPD, asthma, Ischemic heart disease.

He/She give past history of tuberculosis/ no past history of tuberculosis.

Important facts:

Diabetes and cataract

Early onset of senile cataract

True diabetic cataract is called snow flake cataract or snow storm cataract.

When blood sugar levels are elevated above 200 mg/ml the enzyme hexokinase is saturated and remaining glucose is converted by aldose reducatase to sorbitol which accumulates in the lens fibers and causes cataract by osmotic stress.

Other Ocular signs in diabetes

Transient variation in refraction as hyperglycemia causes increased refractive index of the lens causing myopic shift and hypoglycemia causes decreased refractive index of the lens causing hypermetropic shift.

Increased incidence of

Extraocular muscle paresis/paralysis

Stye and internal hordeolum

Infective keratitis

Vitreous hemorrhage, central retinal vein occlusion, primary open angle glaucoma, neovascular glaucoma.

Diabetic retinopathy

Delayed epithelial healing due to abnormality in epithelial basement membrane.

6. *Family history:* Significant/not significant

His/Her father/mother/both had history of cataract/cataract surgery.

His/Her brothers/sisters had history of cataract/cataract surgery.

Important facts:

Heredity plays an important role in age of onset and maturation of senile cataract.

7. *Personal history:*
   - Diet
   - Appetite
   - Habits

Important facts:

Deficiency of proteins, calcium, essential elements such as copper, selenium and zinc has been postulated in the development of cataract.

Vitamins E and C and riboflavin are involved in lens metabolism, by acting as antioxidants they prevent cataract formation.

8. *Socioeconomic history:*

He/She belongs to

- Upper class
- Middle class
- Lower class

Important facts:

Cataract is more common in people of poor socioeconomic status.

For management socioeconomic status plays an important role in advising the type of surgery and type of IOL considering the affordability of the patient.

Surgeries in camp set-up are done free of cost. Cataract surgeries with multifocal IOL cost around fifty thousand rupees!

Diagnosis of cataract

History:painless diminision of vision insidious in onset and gradually progressive

On Examination

Visual Acuity decreased

Immature cataract:
6/6p (p indicates person can read only a part of the 6/6) to counting fingers close to face.
Mature cataract: Hand movements, perception of light and projection of rays present.
Hypermature cataract: Perception of light and projection of rays present.

LENS OPACITY
Immature cataract
Grayish white
Iris shadow present
Purkinje images all 4 present
Mature cataract
Pearly white
Iris shadow absent
Purkinje images first 3 are present

Hypermature cataract
Milky white
Iris shadow absent
Purkinje images first 3 are present

Complete loss of vision, i.e. Perception of light-(PL) negative can never be caused by cataract.

Diseases of lens or cornea can never cause PL negative unless there is a problem in retina and or in optic nerve.

Lens anatomy

- Transparent biconvex crystalline structure
- Anteroir surface—radius of curvature 10 mm
- Posterior surface—radius of curvature 6 mm
- Refractive Index—1.39
- Total power—16D
- Accomodation 14–16D (at birth)
  7–8D (at 25 yrs)
  1–2D (at 50 yrs)

Lens transparency

Lens is transparent due to

- Regular arrangement of lens fibers.
- Presence of protective factors like glutathione in high concentration which protect the lens against oxidative damage
- Avascularity of lens
- Pump mechanism of lens which maintains it in a state of relative dehydration.

Cataract is the most common cause for blindness in India accounting for 62.6 percent of the blindness.

Refractive error 19.7 percent, corneal opacity 0.9 percent, glaucoma 5.8 percent are the other leading causes in India.

CATARACT DISCUSSION

Cataract

Cataract is defined as opacification of lens and or its capsule, congenital or acquired, progressive or stationary, partial or complete, with or without visual impairment.

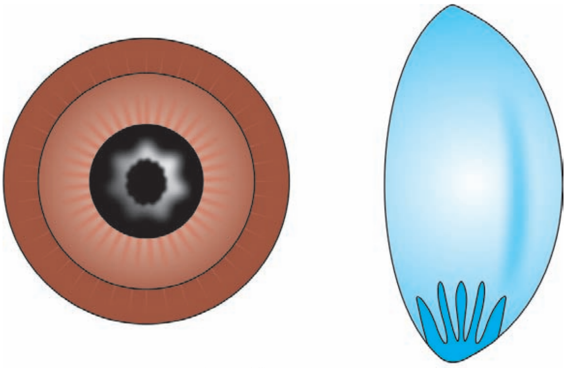
The Word Cataract Literally Means Water Falls

It implies that vision of a patient with cataract is foggy as if he is seeing through a glass covered with water droplets and it also indicates the colour of the lens in total cataract (mature cataract) is white as that of water falls.

Classify Cataract

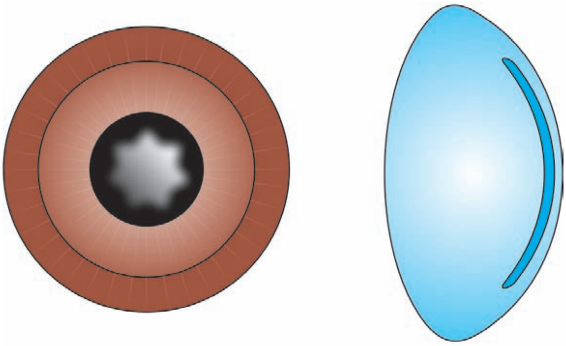
Etiological Classification

Broadly classified as congenital or developmental cataract and acquired cataract which is again classified into:



Cuneiform cataract

Note: Wedge shaped opacities in the periphery



Cupuliform cataract

Note: Central bow shaped opacity

Fig. 4.1A: Cuneiform and cupuliform cataract

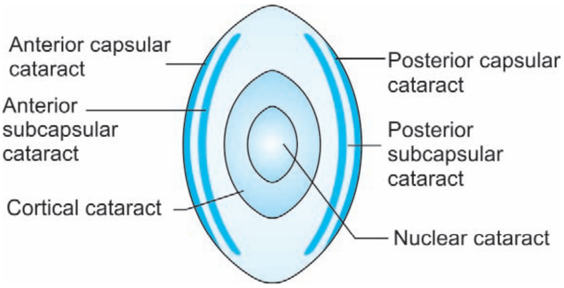

Anterior capsular cataract
Anterior subcapsular cataract
Cortical cataract
Posterior capsular cataract
Posterior subcapsular cataract
Nuclear cataract

Fig. 4.1B: Morphological types of cataract

- Senile cataract
- Metabolic cataract
- Complicated cataract
- Traumatic cataract
- Electric cataract
- Radiational cataract
- Toxic cataract
- Cataract associated with skin diseases
- Cataract associated with syndromes.

Morphological Classification

- Capsular cataract—anterior capsular and posterior capsular cataract.
- Subcapsular cataract—anterior subcapsular and posterior subcapsular cataract.
- Cortical cataract.
- Supranuclear cataract.
- Nuclear cataract.
- Polar cataract—Anterior polar and posterior polar cataract.

With Respect to Maturity

- Incipient cataract
- Immature cataract
- Mature cataract
- Hypermature cataract.

With Respect to Age of Onset

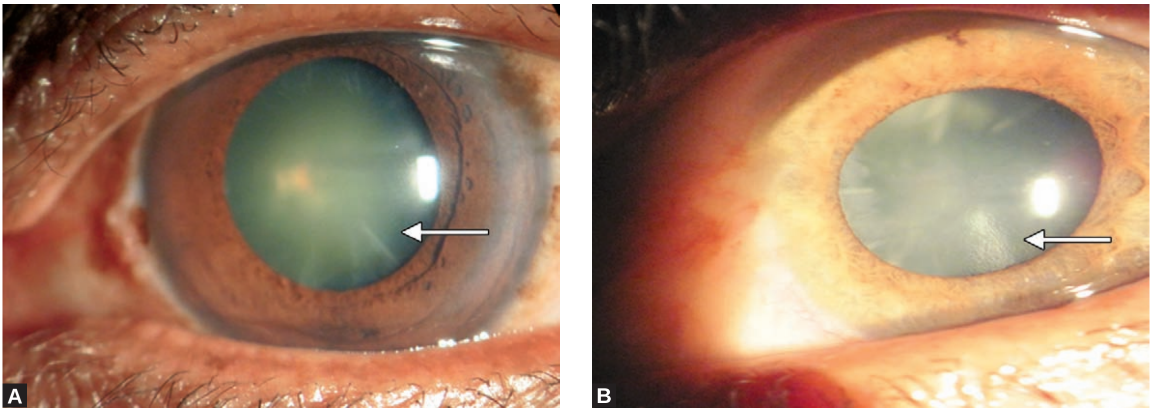
- Congenital cataract
- Infantile cataract
- Juvenile cataract
- Presenile cataract
- Senile cataract.

Senile Cataract

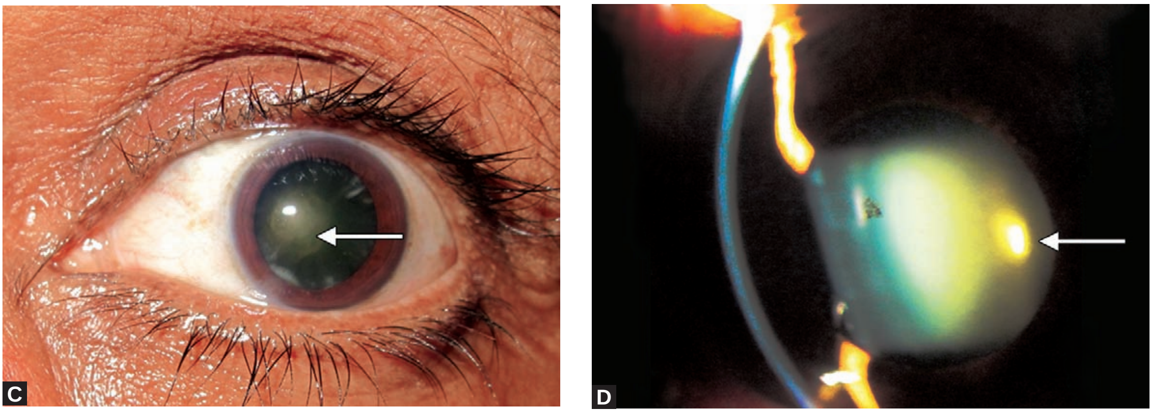
Senile cataract is defined as opacification of lens because of age related changes and characterized by absence of congenital, secondary or other specific causes.

Stages of Maturation of Cataract

- Stage of lamellar separation
- Stage of incipient cataract
- Immature cataract
- Mature cataract
- Hypermature cataract.



Figs 4.2A and B: (A) Early immature cataract (subtype: cuneiform cataract); (B) Advanced immature cataract (subtype: cuneiform cataract). *Note:* Grayish white wedge shaped opacities present in the periphery



Figs 4.2C and D: Immature cataract: Subtype posterior subcapsular cataract (cupuliform cataract). *Note(C):* Grayish white color of the lens. *Note(D):* The presence of opacity in the center of the posterior cortex as shown in the slit-lamp section of lens

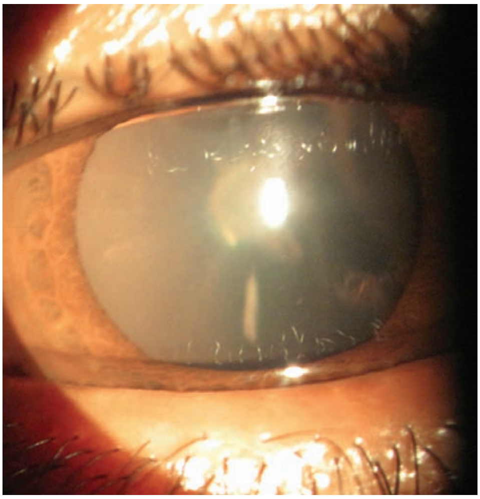


Fig. 4.2E: Posterior polar cataract. *Note:* The presence of lens opacity in the center of the lens at the posterior pole

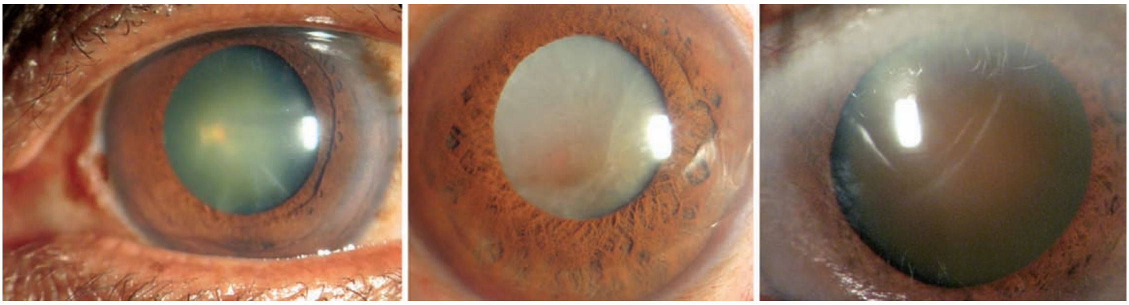


Fig. 4.2F: Grading of nuclear sclerosis. *Note:* Yellowish color in the center (in nucleus)—Grade I nuclear sclerosis Orange color in the center (in nucleus)—Grade II nuclear sclerosis Brown color in the center (in nucleus)—Grade III nuclear sclerosis (Cataracta Brunescens)

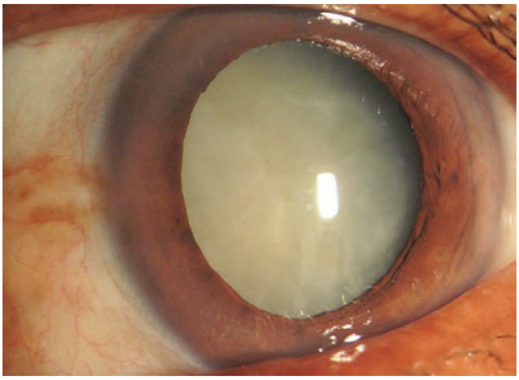


Fig. 4.2G: Immature cataract*. Note:* The presence of iris shadow

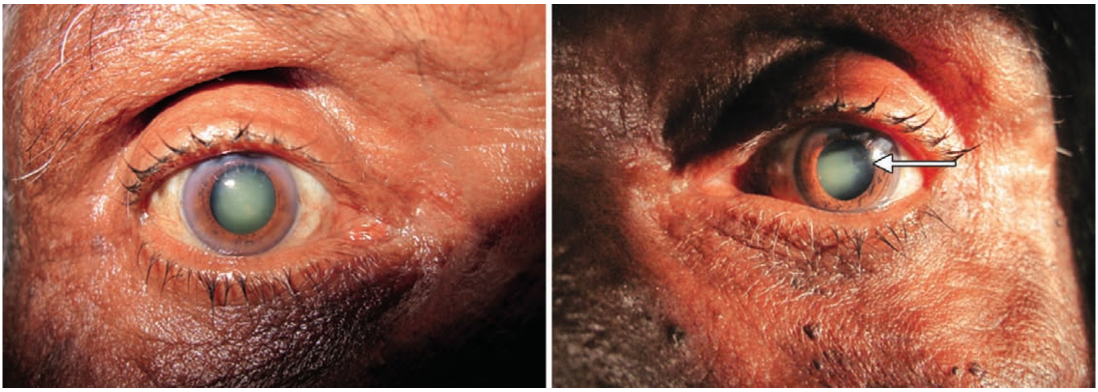
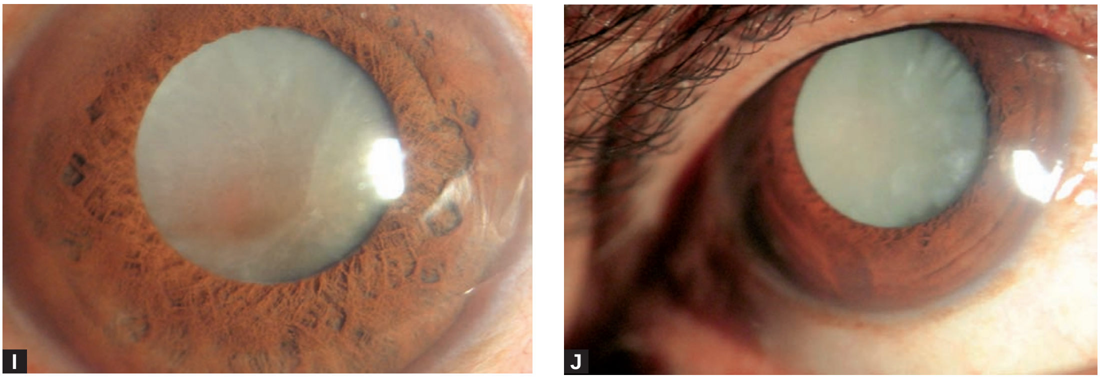
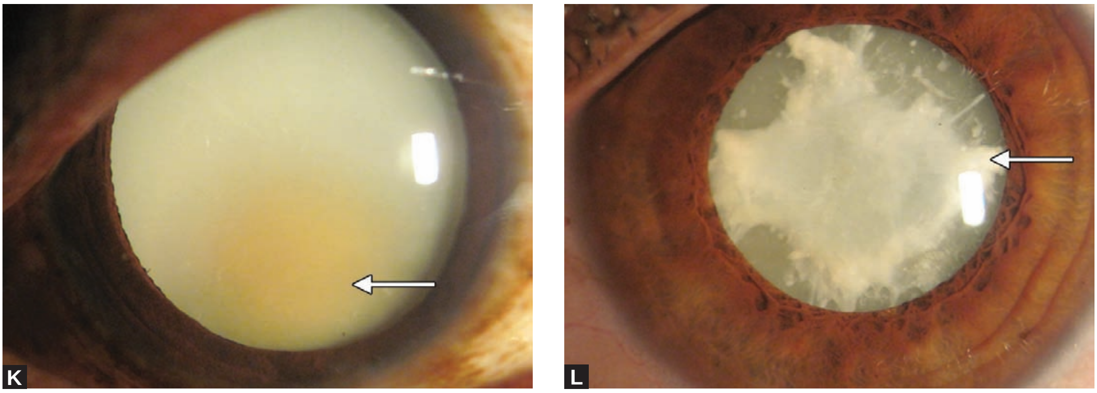


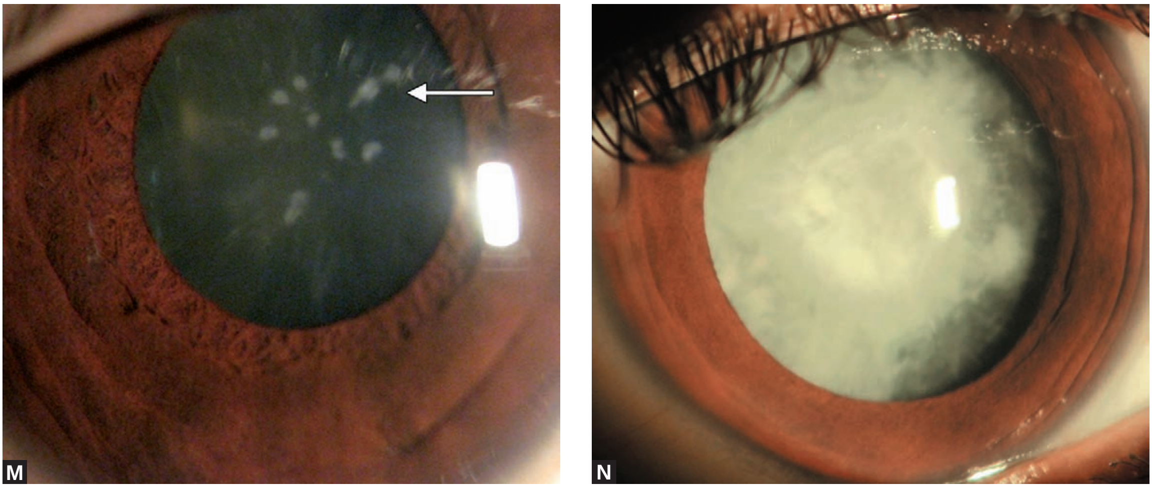
Fig. 4.2H: Demonstration of iris shadow. *Note:* The presence of crescentic shadow of the iris in second photo on the temporal side when light is directed on the eye from temporal side



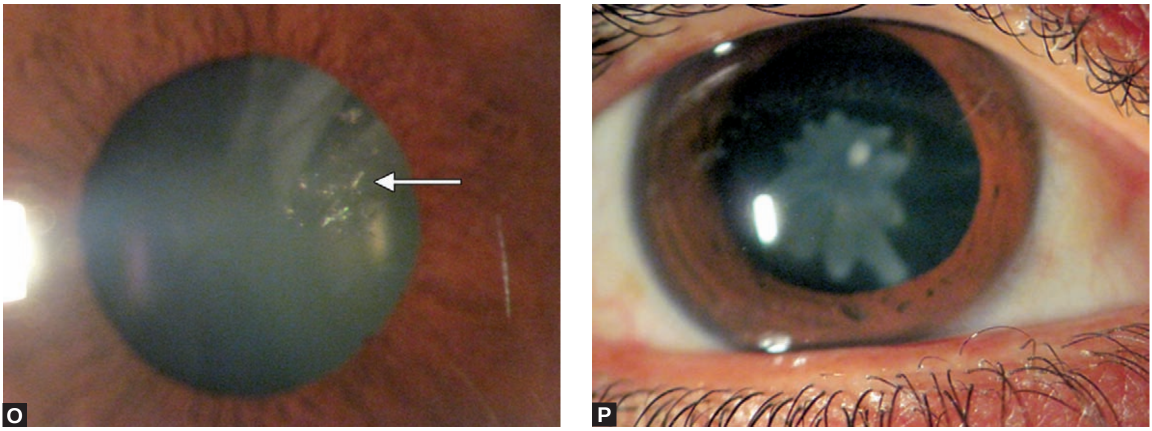
Figs. 4.2I and J: Mature cataract***.*** *Note:* Pearly white color of the lens



Figs 4.2K and L: Hypermature cataract; (K) Subtype: Morgagnian cataract. *Note:* The presence of milky white color of the lens with nucleus sinking at the bottom of the capsular bag of lens as indicated by brown tinge inferiorly; (L) Subtype: Sclerotic hypermature cataract. *Note:* Milky white color of the lens with calcification of anterior capsule



Figs 4.2M and N: (N) Anterior capsular cataract. *Note:* The presence of anterior capsular opacities; (O) Complicated cataract. *Note:* The presence of yellowish, dirty, chalky white color of the lens



Figs 4.2O and P: (O) Polychromatic lusture in a patient with complicated cataract; (P) Rosette cataract seen after blunt trauma

What is Intumescent Cataract?

Increased hydration of lens causing the lens to become swollen is called intumescent cataract. It can occur in immature stage or in mature cataract stage.

What is Morgagnian Cataract?

It is a type of hypermature cataract where the cortex is liquefied and the brownish nucleus settles at the bottom.

What are the Types of Hypermature Cataract?

Morgagnian cataract—as described above

Sclerotic cataract—the lens becomes shrunken due to dehydration and anterior capsule is wrinkled and thickened.

What is Second Sight?

Improvement in near vision in patients with nuclear sclerosis due to progressive index myopia.

What is Complicated Cataract?

- Cataract secondary to some other intraocular disease like
  - Inflammations—uveitis, endophthalmitis.
  - Degenerations—myopic chorioretinal degenerations, retinitis pigmentosa.
  - Intraocular tumors—malignant melanoma, retinoblastoma.
  - Glaucoma
  - Long standing retinal detachment

What are the Characteristic Features of Complicated Cataract?

- Bread crumb appearance
- Polychromatic luster

Classify Congenital Cataract

- Lamellar cataract
- Cataracta centralis pulverulenta
- Sutural cataract
- Blue dot cataract
- Anterior polar cataract
- Posterior polar cataract
- Total congenital cataract.

What is the Mechanism of Cataract Formation?

- Cortical cataract
  - Decreased levels of proteins, amino acids and potassium.
  - Increased levels of sodium, hydration of lens and coagulation of proteins.
- Nuclear cataract
  - Dehydration and compaction of nucleus.
  - Increase in water insoluble proteins.

What is Nuclear Cataract?

Because of age related sclerosis the lens becomes inelastic and hard leading to decrease in the ability of the lens to accommodate and to transmit rays. Types of nuclear cataract are tinted due to pigments

- Brunescens (brown cataract)
- Rubra (red cataract)
- Nigra (black cataract).

How do you Grade Nuclear Sclerosis?

- Grade I Grayish yellow
- Grade II Grayish orange
- Grade III Grayish brown
- Grade IV Black

What is Iris Shadow?

Crescenteric shadow of pupillary margin of iris formed on the grayish opacity of the lens when an oblique beam of light is thrown on the pupil is called as iris shadow. When lens is completely transparent or opaque no iris shadow is formed. Hence iris shadow is a sign of immature cataract.

Why Iris Shadow is Seen?

For shadow to form the requirement is transparent media which allows light and opaque media which acts as a screen on which the image is formed, this requirement is fulfilled only in immature cataract. Normally lens is completely transparent, in mature and hypermature cataract lens is completely opaque hence iris shadow is not seen in these two conditions and seen only in immature cataract in which lens is partly transparent and partly opaque.

Name Retinal and Macular Function Tests

Retinal Function Tests

- *Light discrimination test:* In a dark room a cardboard having 4 holes wide apart in 4 quadrants with a light source behind it is placed infront of the patient, if the patient appreciates 4 light sources it indicates good retinal function.

- *Projection of rays:* The patient is asked to identify the direction of light by which light is coming by projecting light from various directions. If the patient can identify the direction from which light is coming, it indicates good retinal function.
- *Entoptic visualization:* It is done by placing a point source of light against the closed eyelids, and asking the patient if he can perceive the retinal vascular pattern. The presence of entoptic visualization indicates good retinal function.
- *Test for Marcus Gunn pupillary response:* Which indicates afferent pathway defect.
- *B scan:* To detect anatomical state of retina and vitreous.
- Electroretinogram.
- Electro-oculogram.
- Visual evoked potential.

Macular Function Tests

- *Cardboard test (Two point discrimination):* Patient is asked to see through a cardboard with two holes close to each other with light behind the holes if two lights are appreciated, it indicates good macular function.
- *Maddox rod test:* Patient is asked to look through a maddox rod at a bright light, if the patient sees continuous unbroken and undistorted redline then the macula is normal. If the line is broken it indicates macular pathology.
- *Amsler grid test:* Can be used in eyes with better vision.
- Patient is asked to close one eye and to see at amsler's chart with the other eye holding the chart at normal reading distance. Patient is asked to look for any distortion in the grid while looking at the central fixing dot when present distortion indicates macular pathology. The test is repeated in the other eye.
- *Laser interferometry:* It is an instrument used to detect grating visual acuity in the presence of opaque media.
- *Potential acuity meter:* With slit lamp miniature snellen's chart is projected into the eye and the macular function can be judged by lines read by the patient.

How do you Calculate IOL Power?

Calculation of IOL power

Without biometry

Using standard power +19D

Based on basic refraction (refractive error present prior to the onset of cataract).

P = +19D + (1.25R)

P = Implant power, R = Basic refractive error

With biometry

Using regression formulae

SRK-I, SRK-II, SRK/T, MODIFIED SRK-II, HOLLADAY….

SRK (SANDERS RETZLAFF KRAFF) formulae are most commonly used

P = A-2.5L-0.9K

P = Implant power, A = Constant, L = axial length

K = corneal power in diopter

Value of A:

For PC IOL 118.2 (The value of constant varies with the type of lens)

For AC IOL 114

What is Presenile Cataract?

Cataract formation because of age related changes in people aged less than fifty years is called presenile cataract.

In all cases of presenile cataract other causes for cataract have to be ruled out, i.e. trauma, metabolic diseases like diabetes, intraocular diseases causing complicated cataract, drug intake like corticosteroids and other drugs causing cataract, skin diseases causing cataract.

Some specific type of cataracts and their causes

Snow flake cataract	Diabetic cataract
Oil droplet cataract	Galactosemic cataract
Sunflower cataract	Inborn errors of copper metabolism, e.g. Wilsons disease
Glassbowlers cataract	Prolonged exposure to heat
Toxic cataract	Long-term use of steroids, miotics like echothiophate, demecarium bromide
Syndermatotic cataract	Cataract with skin diseases

What is the Work-up for a Patient with Cataract Posted for Cataract Surgery?

Diagnosis of Cataract

History: Diminision of vision insidious in onset and gradually progressive

On Examination:

1. *Decrease in visual acuity varying according to the stage of cataract:* In immature cataract-6/6 parts to counting fingers close to face(6/6 parts (cannot read complete letters in 6/6, can read only a part of it).
   In mature cataract—hand movements, perception of light and projection of rays
   In hypermature cataract—perception of light and projection of rays
2. *Presence of lens opacity*
   - Grayish white opacity and iris shadow present—immature cataract
   - Pearly white opacity—mature cataract
   - Milky white opacity—hypermature cataract.

> Eye has got two refractive structures cornea and lens which project light rays on to the retina, which travel via optic nerve to the visual sensory area in the occipital lobe.
>
> Diminision of vision should have problem in one of these structures or there can be a problem in all three or two structures at the same time.

Confirm Diagnosis/Exclude Other Associated Causes For Diminision of Vision

Slit lamp examination/anterior segment examination to rule out corneal disorders like dystrophies, degenerations. Pterygium encroaching the pupillary area.

Retinoscopy to Rule Out Refractive Error

Ophthalmoscopic examination of retina (fundoscopy), to look for retinal pathologies like age related macular degeneration, chorioretinal degeneration, optic atrophy.

Intraocular pressure measurement to rule out ocular hypertension and glaucoma.

So we have ruled out other causes/associated causes, i.e. diagnosis is confirmed.

Systemic Investigations to Confirm Fitness of the Patient for Surgery

Urine sugar/random blood sugar (RBS) to rule out diabetes mellitus. If the patient is known diabetic, fasting and postprandial blood sugar (FBS and PPBS) has to be done.

Blood pressure measurement to rule out hypertension.

ECG (Electrocardiogram) to know the cardiac status.

If the patient is known to have chronic disorders like COPD, IHD.... they have to be controlled before posting the patient for surgery.

HIV and HBsAG to take safety precautions if the patient is seropositive.

Rule out any potential source of infection like infected abscess,open infected wound which may act as a foci for development of endophthalmitis.

Ocular Investigations

Rule out any ocular infections/inflammatory diseases like conjunctivitis, stye, chronic dacryocystitis.../active uveitis.....

Lacrimal syringing to rule out chronic dacryocystitis.

Retinal and macular function tests to know visual prognosis.

Biometry for calculation of IOL power which includes keratometry and a scan.

Xylocaine test dose to rule out hypersensitivity to xylocaine.

To summarize

Systemic:
- Urine sugar/RBS
- BP
- ECG
- HIV
- HBsAG
- Evaluation of any chronic disorder and treating it appropriately
- Rule out any septic foci of infection anywhere in the body

Ocular:
- Measurement of intraocular tension
- Lacrimal syringing
- Retinal and Macular function tests
- Biometry.

What are the Differential Diagnosis for Immature Cataract?

Immature cataract has to be differentiated from nuclear sclerosis.

	Immature cataract	*Nuclear sclerosis*
Vision	Diminision of vision, painless and progressive in nature No improvement with pin hole	Diminision of vision, painless and progressive in nature Improvement with pin hole
Anterior segment examination	Grayish white color of the lens, iris shadow present	Grayish color of the lens (color varies according to the grade of nuclear sclerosis) iris shadow absent
Distant direct ophthalmoscopy	Black spots against red background	Only red glow is seen

What are the Differential Diagnosis of Mature and Hypermature Cataract?

Mature and hypermature cataract have to be differentiated by pseudoglioma.

	Mature cataract and hypermature cataract	*Pseudoglioma*
Vision	Decreased, painless and progressive in nature	Decreased, nature of diminision of vision depends on the cause
Pupil	White color	White color and pupil is usually semidilated
Anterior segment examination	Cataractous lens, fourth Purkinje image absent	Clear lens, opacity behind the lens Fourth Purkinje image present
B scan	Normal	Vitreous/retinal pathology seen

Pseudoglioma

It includes conditions which present as leukocoria other than retinoblastoma (Glioma). Common conditions included in this list are:

- Retinopathy of prematurity
- Persistent hyperplastic primary vitreous
- Toxocara endophthalmitis
- Coat's exudative retinopathy.

What is Intracapsular Cataract Extraction?

Intracapsular cataract extraction (ICCE) entire cataractous lens is removed along with intact capsule.

Not done nowadays.

The indication for ICCE is dislocated lens into anterior chamber.

What is Extracapsular Cataract Extraction?

Extracapsular cataract extraction (ECCE)

Cataractous lens is removed leaving behind intact posterior capsule. It is of three types:

- Conventional ECCE
- SICS (Small incision cataract surgery)
- Phacoemulsification.

Whar are the Steps of SICS?

- Local anesthesia, peribulbar block is the preferred one
- Preparation of the eyeball by painting the eye with povidone iodine and draping the eye with eye towel
- Insertion of the wire speculum
- Superior rectus stitch or bridle suture for fixation of the globe
- Conjunctival peritomy and cauterization of the bleeding vessels
- Scleral groove and sclerocorneal tunnel construction using crescent blade
- Paracentesis or side port entry into anterior chamber
- Forming the anterior chamber with viscoelastic
- Capsulotomy or capsulorhexis
- Entry into anterior chamber with keratome and enlargement of the wound up to 5.5–6.5 mm
- Hydrodissection and hydrodelineation
- Removal of nucleus and cortical matter
- IOL insertion
- Formation of anterior chamber
- Closure of conjunctiva and subconjunctival injection of antibiotic with steroid
- Pad and bandage.

What are the Methods of Nucleus Delivery in SICS?

- *Phacosandwich method:* Nucleus is removed by sandwiching between lens loop and spatula
- *Phacofracture:* Nucleus is removed by cutting it into two or more pieces
- *Phacofragmentation:* Nucleus is removed by fragmenting the nucleus into multiple small pieces by nucleus fragmentor
- *Fish hook technique:* Nucleus is removed by hooking it with a hook mounted on a 1 ml syringe
- *Blumenthal technique:* Nucleus is removed by using a anterior chamber maintainer and a lens glide
- *Irrigating vectis:* Nucleus is removed by inserting a irrigating vectis.

What is the Relation between Corneal Astigmatism and Scleral Incision?

Corneal astigmatism is directly related to the cube the length of the incision and it is inversely related to the distance of the incision from the limbus.

Hence, shorter incisions close to the limbus and longer incisions away from limbus have the same effect on corneal astigmatism.

The preferred incisions are straight and frown shaped incision which produce less astigmatism when compared to smile incision or incision along the limbus (C shaped).

What is Hydrodissection and Hydrodelineation?

Injection of fluid under the anterior capsule to separate the cortex and nucleus from capsule is called hydrodissection.

Injection of fluid into the cortical layer of the lens to separate the outer soft epinucleus from inner compact inner nucleus is called hydrodelineation.

What is the Anesthesia used for Cataract Surgery?

General anesthesia—for children, mentally retarded and noncooperative patients local anesthesia.

- Retrobulbar anesthesia
- Peribulbar anesthesia
- Subtenon's anesthesia.

> Peribulbar anesthesia is the preferred and most commonly used for small incision cataract surgery as the risk of complications associated with peribulbar block is low while retaining all the advantages of retrobulbar block.

Lignocaine 2 percent with duration of action 45 mins–2 hours and bupivacaine 0.75 percent with duration of action 5–8 hours are the most commonly used anesthetic agents for infiltration anesthesia.

Lignocaine 4 percent and proparcaine are used for topical anesthesia.

What are the Complications of Cataract Surgery?

During anesthesia:

- Globe perforation
- Intravascular injection
- Damage to optic nerve
- Brainstem anesthesia
- Oculocardiac reflex (sinus bradycardia)
- Retrobulbar hemorrage.

During surgery (operative)

- Irregular incision
- Injury to cornea
- Detachment of Descemet's membrane
  - Damage to endothelium
- Damage to iris and ciliary zonules
  - Iridodialysis
  - Zonular dialysis
- Damage to posterior capsule
  - Posterior capsular tear
  - Vitreous loss
  - Posterior loss of lens fragments.
- Expulsive choroidal hemorrage.

Early postoperative (within 3 weeks)

- Iris prolapse
- Shallow anterior chamber either because of wound leak or pupillary block glaucoma
- Residual lens matter
- Severe postoperative inflammation (iridocyclytis, phacotoxic uveitis, etc.)
- Endophthalmitis
- Hyphema
- Striate keratopathy.

Late postoperative

- Cystoid macular edema
- Posterior capsular calcification (After cataract)
- Anterior capsular contracture (phimosis)
- Retinal detachment
- Corneal endothelial decompensation
- Vitreous touch syndrome (Irvine Gass syndrome)-vitreous touch, bullous keratopathy and cystoid macular edema
- Epithelial ingrowth
- Fibrous downgrowth.

IOL related Complications

Described under pseudophakia.

What is the Postoperative Management After Cataract Surgery?

Postoperatively dressing is removed after 6 hours of surgery.

Antibiotic—steroid eyedrops e.g. ofloxacin-prednisolone acetate, gatifloxacin-prednisolone acetate are prescribed for 6 weeks in tapering dosage

- 10 times per day in first week
- 8 times per day in second week
- 6 times per day in third week
- 4 times per day in fourth week
- 3 times per day in fifth week
- 2 times per day in sixth week.

Nonsteroidal eyedrops like flurbiprofen, ketorolac are prescribed 4 times per day for 6 weeks.

Patient is seen on the first postoperative day, after 2 weeks and after 6 weeks.

Visual rehabilitation in the form of spectacles are prescribed after 6 weeks.

Visual rehabilitation

Final spectacle correction is given after

- Four weeks after phacoemulsification
- Six weeks after SICS
- Eight weeks after suture removal in ECCE conventional

Postoperative Instructions

- Not to rub the operated eye
- Avoid exposure of the operated eye to dust and smoke
- To use protective eye goggles for 2 weeks
- No head bath for 2 weeks
- To use prescribed eyedrops as per the advice
- To report immediately if the patient notices pain, redness and diminision of vision.

What are the Complications of Cataract if it is not Operated even after its Maturation?

Lens induced glaucomas

- Phacomorphic glaucoma-because of intumescent lens.
- Phacolytic glaucoma-because of leakage of lens proteins into anterior chamber.
- Phacoanaphylactic uveitis-because of hypersensitivity to lens protein.

Subluxation or dislocation of lens because of degeneration of ciliary zonules.

Lens induced glaucomas

Phacomorphic glaucoma: It is because of angle closure or pupillary block due to increase in the size of the lens. Here anterior chamber is shallow and lens is intumescent.

Phacolytic glaucoma: It is secondary open angle glaucoma caused by clogging of trabecular meshwork by lens proteins and macrophages. Here anterior chamber is deep with hypermature cataract.

The treatment for lens induced glaucomas include reduction of IOP followed by lens extraction.

What are the Retinal Function Tests/ Investigations to be done before Operating on Mature and Hypermature Cataract?

Test for Marcus Gunn pupillary response which indicates afferent pathway defect.

Projection of rays—crude but easy test for assessing the status of peripheral retina.

B Scan—to detect anatomical state of retina and vitreous.

Pediatric cataract

Pediatric cataracts include cataracts from birth to adolescence.

Cataracts in this age group along with reducing vision also interfere with the visual development. Hence its management is difficult as it includes treatment for cataract and management of amblyopia.

Etiology

Heredity: Due to anomaly in the chromosomal pattern

Maternal factors: During pregnancy

- Infections like rubella, toxoplasmosis
- Drug ingestion like steroids, thalidomide
- Exposure to radiation
- Malnutrition.

Fetal factors

- Metabolic diseases like hypoglycemia, galactosemia, Lowe's syndrome
- Birth trauma
- Malnutrition

Types of pediatric cataract

- Lamellar cataract
- Cataracta centralis pulverulenta
- Sutural cataract
- Blue dot cataract
- Anterior polar cataract
- Posterior polar cataract
- Total congenital cataract.

Laboratory tests for bilateral pediatric cataracts

- TORCH titer (toxoplasma, rubella, cytomegalovirus and herpes simplex virus).
- Urine assay for reducing substances (to rule out galactosemia), aminoacids (to rule out Lowe's syndrome)
- Plasma calcium and phosphorus
- Blood sugar.

Timing of surgery in congenital cataract

Congenital cataract unilateral or bilateral should be operated as early as possible within few weeks of birth.

Unilateral cataract should be operated within few weeks of birth as early as possible. Till the time of surgery on the cataractous eye, normal eye has to be occluded to prevent amblyopia in the cataractous eye.

Bilateral cataracts should be operated within a few weeks of birth as early as possible to prevent stimulus deprivation amblyopia.

Unilateral congenital cataract is associated with more incidence of amblyopia when compared to bilateral congenital cataract.

Management

Children's eyes are smaller,softer and inflammatory response is more when compared to adults eyes.

Two important aspects which have to be taken care are amblyopia and after cataract (incidence of after cataract is almost 100 percent in children below 2 years because of active multiplication of lens firbers).

< 2 years of age

IOL insertion below 2 years of age is still controversial as it is more difficult technically because of small structures of the eye hence not practiced by all, but if possible should be most ideal because it helps in better management of amblyopia.

If IOL insertion is planned

Limbal approach: ECCE with posterior chamber IOL with primary posterior capsulorhexis to keep the visual axis clear, i.e. to prevent the development of after cataract.

If IOL insertion is not planned

Limbal approach: ECCE without IOL implantation

Pars plana approach: Approach through pars plana, i.e. about 3.5 mm behind the limbus.

Through pars plana, lensectomy and vitrectomy is completed thus it allows a permanently clear visual axis and spares the anterior segment from postoperative inflammation. Later once the age of the patient crosses 2 years IOL is inserted through limbal approach.

2–8 years of age

In children > 2 years of age, the eye would have reached nearly adult size hence the surgery of choice is through limbal approach.

ECCE with posterior chamber IOL implantation

Primary posterior capsulorhexis is not compulsory as the incidence of after cataract decreases after 2 years and if at all it develops it can be treated by YAG capsulotomy as the child will be cooperative to sit at the slit lamp by this age.

Guidelines for choosing IOL power in pediatric cataract

>2 years old

Biometry is done and it is undercorrected by 20 percent, i.e. only 80 percent of the power required is implantated.

2–8 years of age

Biometry is done and it is undercorrected by 10 percent, i.e. only 90 percent of the power required is implantated.

>8 years of age

Same as adults.

Treatment to prevent amblyopia

If IOL is implanted spectacles for astigmatism induced by surgery as calculated by refraction are given by 4 months onward.

Bifocals with near addition for reading are given by 3 years onward.

Cases of bilateral pseudophakia are followed closely to detect and treat amblyopia.

Cases of unilateral pseudophakia are given occlusion therapy starting from 4 months to 4 years and then gradually reduced till the age of the child is 12 years.

If IOL is not implanted aphakic correction has to be given immediately from next day of surgery and rest is same as in case of IOL implantation.

Cataract with glaucoma

Senile cataract may be associated with glaucoma as both are seen in elderly age people.

The treatment options are:
Surgery for cataract and medical treatment/ laser trabeculoplasty or trabeculectomy (surgical treatment of glaucoma).

Cataract surgery alone with medical treatment for glaucoma is the preferred treatment for cases in which glaucoma is well controlled with low dose medical regimen with little or no glaucomatous damage.

Simultaneous cataract and glaucoma surgery (trabeculectomy) is indicated in cases with:

- Uncontrolled glaucoma with maximal medical treatment
- Intolerance to medical treatment or noncompliance to medical treatment
- Advanced glaucoma.

Before operating on patients with cataract and glaucoma together proper evaluation of the glaucoma should be done by measurement of intraocular pressure, visual fields examination, assessing optic disk changes due to glaucoma.

Cataract with pterygium

Cataract and pterygium are more frequently seen in association.

Cataract and pterygium excision can be done together or separately depending on the surgeon's preferences.

Cataract with atrophic pterygium—requires treatment for only cataract in the form of cataract surgery as atrophic pterygium is usually asymptomatic and would not require surgical intervention.

Cataract surgery with pterygium excision together

Advantage: Operating for both pterygium and cataract during same setting will cure both at once and hence would not require second surgery.

Cataract with progressive pterygium not crossing pupillary area-combined surgery, cataract surgery first followed by pterygium excision during the same setting.

In cases with progressive pterygium crossing pupillary area and obscuring the view of the lens making the cataract surgery difficult, pterygium excision can be done first followed by cataract surgery during the same setting.

Disadvantage: Pterygium excison will lead to epithelial defect of the cornea and it is not wise to use potent steroids (required Postoperatively following cataract surgery) with corneal epithelial defect as it may get infected.

Cataract surgery with pterygium excision separately

Advantage: It avoids the risks associated with using steroids with corneal epithelial defect.

Depending on the cause for visual impairment cataract or pterygium is operated first followed by the other one.

Disadvantage: Patient requires two surgeries.

Cataract with corneal opacity

If the corneal opacity is leucomatous requiring full thickness keratoplasty, both cataract surgery and keratoplasty can be done together.

After removing diseased recepient's cornea and entering anterior chamber open sky extracapsular cataract extraction and IOL implantation is done and keratoplasty is completed by suturing donor cornea to recepient's corneal rim.

This is called triple procedure—cataract extraction + IOL implantation + Keratoplasty.

Cataract when associated with infective conditions

Ocular infective diseases like conjunctivitis, acute dacryocystitis, external hordeolum, internal hordeolum, orbital cellulitis, infective keratitis. Systemic infective conditions like abscess any where in the body, infective ulcer are contraindications for cataract surgery because of risk of endophthalmitis, hence the infective condition has to be treated appropriately before posting the patient for cataract surgery.

Cataract with chronic dacryocystitis

Cataract surgery is contraindicated in patients with chronic dacryocystitis because of risk of endophthalmitis. Chronic dacryocystitis has to be treated first either by DCT (Dacryocystectomy to make the eye safe by removing lacrimal sac which may be reservoir/source of infection) or DCR (Dacryocystorhinostomy to re-establish the patency of lacrimal drainage system).

Treatment protocol:

- In patients with cataract and chronic dacryocystitis first either DCT or DCR has to be done.
- Removal of skin sutures after two weeks.
- Conjunctival swab for culture and sensitivity to confirm the sterile ocular surface a prerequisite for cataract surgery.
- Cataract surgery if conjunctival swab shows no growth of infective organisms (if there is growth appropriate antibiotics depending on the culture and sensitivity report have to be used to make the eye sterile before proceeding to cataract surgery).

Cataract with ocular inflammatory conditions

In cases where cataract is associated with non-in- fective inflammatory conditions like acute iridocyclitis. Cataract surgery should only be done once the active inflammation is treated with appropriate treatment because of the risk of increased postoperative ocular inflammation.

Cataract with chalazion

Though chalazion is noninfective performing cataract surgery in the presence of chalazion is contraindicated as.

Chalazion is granulomatous inflammatory condition.

Chalazion may get secondarily infected leading to internal hordeolum.

Hence cataract surgery is performed after treating chalazion.

Medical management of cataract:

It is indicated in early stages of cataract where visual impairment is not significant.

Medical management of cataract involves.

Drugs to delay progression of cataract.

Antioxidants like glutathione, betacarotene, vitamin C.

Aldose reductase inhibitors like Sulindac, Sorbinil.

Treatment of cause of cataract like adequate control of diabetes in case of diabetic cataract, withdrawal of steroids in steroid induced cataract.

Improving vision by refraction and correction, using drugs like mydriatics in small central cataract.

Management of cases when cataract is associated with other ocular and systemic diseases.

CATARACT WITH DIABETES MELLITUS

All patients with diabetes mellitus must be screened for diabetic retinopathy by detailed fundus examination.

If there is no diabetic retinopathy cataract surgery should be performed and patient should be followed as per the screening protocol (as described later).

General instructions for cataract surgery in diabetic patients

Preferably IOL of large diameter, 6.5 mm which facilitates subsequent pan retinal photocoagulation or vitrectomy if required later should be used.

PMMA (Poly methyl meth acrylate) IOL is preferred over silicone IOL as patients may require silicone oil insertion after vitrectomy if needed.

Anterior chamber IOL should be avoided as this may prevent pupillary dilatation there by making it difficult to do panretinal photocoagulation or vitrectomy if required later.

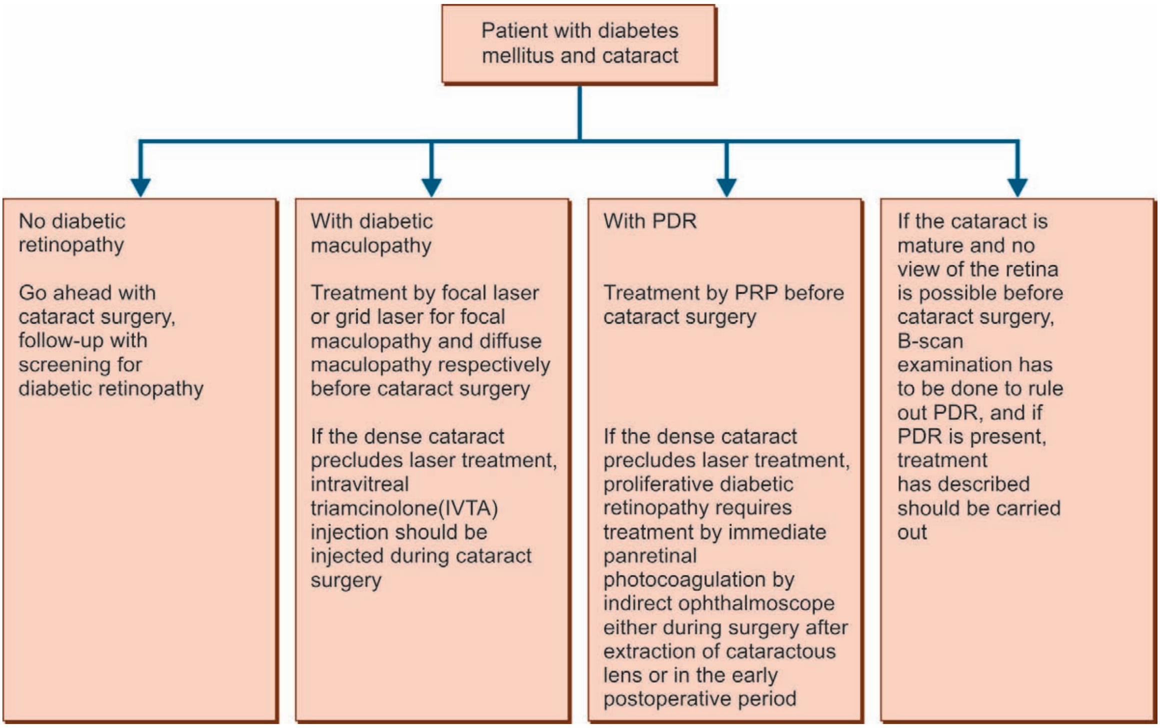
If there is diabetic retinopathy cataract surgery may worsen the diabetic retinopathy leading to poor vision hence it has to be treated before performing surgery.

Diabetic macular edema requires treatment by focal laser for focal diabetic maculop-athy and grid laser for diffuse diabetic maculopathy before cataract surgery.

Proliferative diabetic retinopathy (PDR) should be treated by panretinal photocoagulation (PRP) before cataract surgery.

If the dense cataract precludes laser treatment, Intravitreal triamcinolone acetonide (IVTA) injection should be injected during cataract surgery for diabetic macular edema to prevent worsening of the edema and proliferative diabetic retinopathy requires treatment by immediate panretinal photocoagulation by indirect ophthalmoscope either during surgery or after extraction of cataractous lens or in the early postoperative period.

If the cataract is mature and no view of the retina is possible before cataract surgery, B-scan examination has to be done to rule out PDR and if PDR is present then treatment has described should be carried out.



Patient with diabetes mellitus and cataract

No diabetic retinopathy

Go ahead with cataract surgery, follow-up with screening for diabetic retinopathy

With diabetic maculopathy

Treatment by focal laser or grid laser for focal maculopathy and diffuse maculopathy respectively before cataract surgery

If the dense cataract precludes laser treatment, intravitreal triamcinolone(IVTA) injection should be injected during cataract surgery

With PDR

Treatment by PRP before cataract surgery

If the dense cataract precludes laser treatment, proliferative diabetic retinopathy requires treatment by immediate panretinal photocoagulation by indirect ophthalmoscope either during surgery after extraction of cataractous lens or in the early postoperative period

If the cataract is mature and no view of the retina is possible before cataract surgery, B-scan examination has to be done to rule out PDR, and if PDR is present, treatment has described should be carried out

Screening for Diabetic Retinopathy

Type 2 Diabetes Mellitus

- First screening is done as soon as the diagnosis is made and then once in a year till no diabetic retinopathy or mild nonproliferative diabetic retinopathy (NPDR)
- Moderate NPDR-once in 6 months
- Severe NPDR-once in 3 months
- PDR with no high-risk characteristics-once in 2 months

Type 1 Diabetes Mellitus

- Since the diabetic retinopathy is rare before puberty first screening is done at puberty and rest is same as for type 2 diabetic individuals.

- Screening involves measurement of visual acuity and fundus examination following pupillary dilatation.

Cataract with ischemic heart disease

Cataract surgery should be performed after cardiac evaluation by a physician or a cardiologist. If the patient is on aspirin it should be stopped 5–7 days prior to surgery as this may cause increased bleeding during surgery or hyphema following surgery.

Cataract with chronic pulmonary disease

Cataract surgery should be performed after COPD is well controlled because uncontrolled COPD may cause repeated iris prolapse during surgery or postoperative iris prolapse because of violent coughing.

Cataract with abscess or infected wound anywhere in the body

Cataract surgery should be performed after treating the abscess or infected wound because of the risk of endogenous endopthalmitis if performed in the presence of infection.

PSEUDOPHAKIA

1. *Biodata:*
   Here is a male/female patient aged about .... years, ... by occupation, hailing from ....
2. *Presenting complaints:*

> Pseudophakia will not have any complaints as it is the treatment done for the complaint, i.e. cataract.
>
> All pseudophakics require spectacles to have normal distant and near vision.
>
> All people with pseudophakia will not have near vision as accommodation is completely lost after surgery until unless accommodative IOL or multifocal IOL has been put.
>
> The distant vision depends on the final astigmatism induced by surgery.
>
> ***Causes for diminision of vision in pseudophakia***
>
> - Astigmatism induced by surgery
> - Wrong power IOL implanted causing consecutive myopia or hypermetropia
> - After cataract
> - Cystoid macular edema
> - Retinal detachment
> - Pseudophakic glaucoma
> - IOL related complications.

3. *History of presenting illness:*
   He/She was apparently normal .... months/years back. He/She noticed diminision of vision in RE/LE/BE for which he/she was operated at ...., ... months/years back.
   Before surgery he/she was able to see............ meters, after surgery he/she was able to see ....meters. He/she is wearing spectacles/not wearing spectacles.

> If he/she complains of diminution of vision the same should be evaluated below the headings of onset, duration, associated features.

4. *Ocular history:*
   He/She is/was wearing spectacles for
   – Near vision
   – Distance vision (choose one among three)
   – Both.
5. *Past history:* He/She is a known diabetic on treatment/ not a known diabetic.
   He/She is a known hypertensive on treatment/not a known hypertensive.
   He/She is a known patient of COPD, asthma, ischemic heart disease on treatment/not a known patient of COPD, asthma, ischaemic heart disease.
   He/She gives past history of tuberculosis/no past history of tuberculosis
6. *Family history:* Significant/not significant
   His/Her father/mother/both had history of cataract/cataract surgery.
   His/Her brothers/sisters had history of cataract/cataract surgery.
7. *Personal history:*
   Diet
   Appetite
   Habits
8. *Socioeconomic history:*

> The word pseudophakia literally means false lens.
>
> Pseudophakia is a condition where the natural lens is replaced by artificial lens.
>
> *Pseudophakia can be*
>
> - Posterior chamber IOL (most common)
> - Anterior chamber IOL
> - Iris fixated IOL.

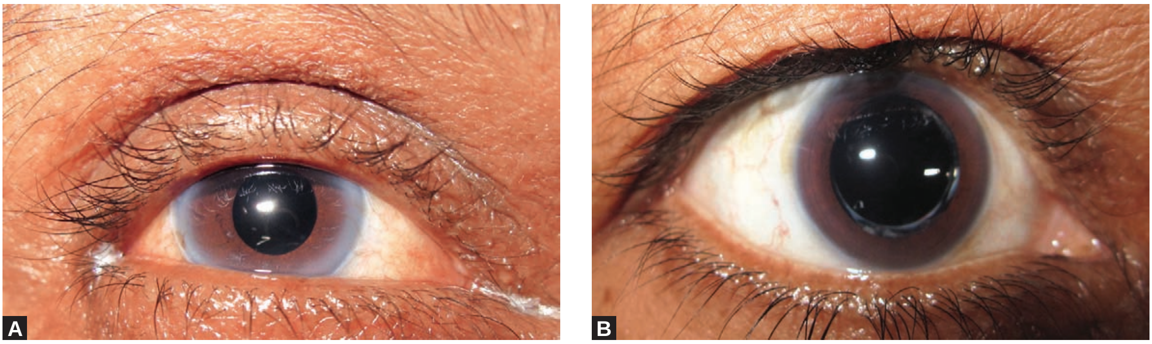
How Pseudophakia is Diagnosed?

Pseudophakia is diagnosed as follows:

- H/O cataract surgery
- Limbal scar may be seen (except in clear corneal phacoemulsification)
- Pupil jet black pupil with shining reflexes
- Posterior chamber IOL—IOL will be behind iris in posterior chamber
- Anterior chamber IOL—IOL will be in front of the iris in anterior chamber.

What is the Refractive Status of a Pseudophakic Eye?

- Emmetropia—the power of the IOL implanted is correct



Figs 4.3A and B: (A) Pseudophakia with posterior chamber IOL look for jet black pupil with shining reflexes; (B) Pseudophakia with posterior chamber IOL after dilatation of pupil. *Note:* The presence of fourth Purkinje image which is absent in aphakia

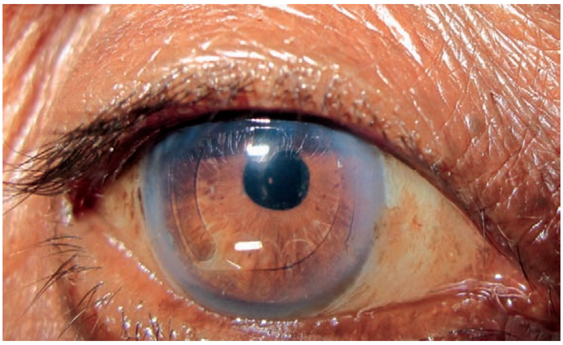
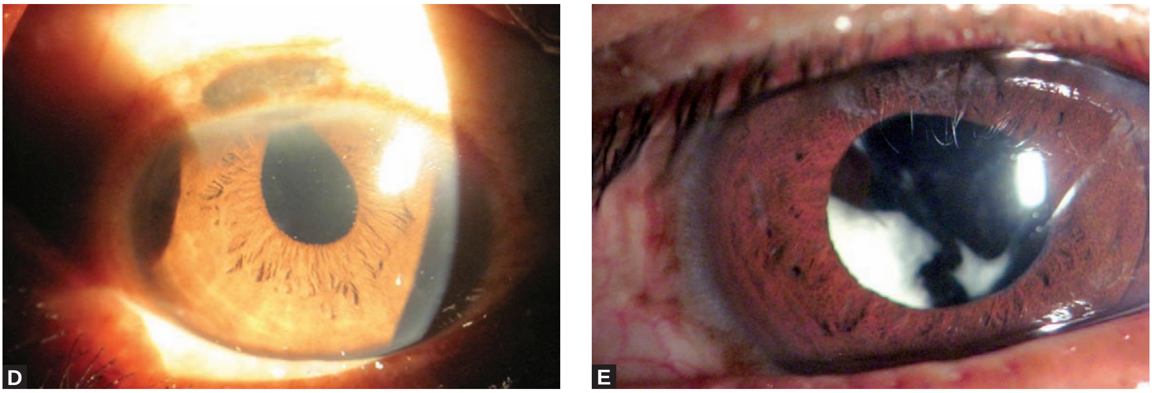
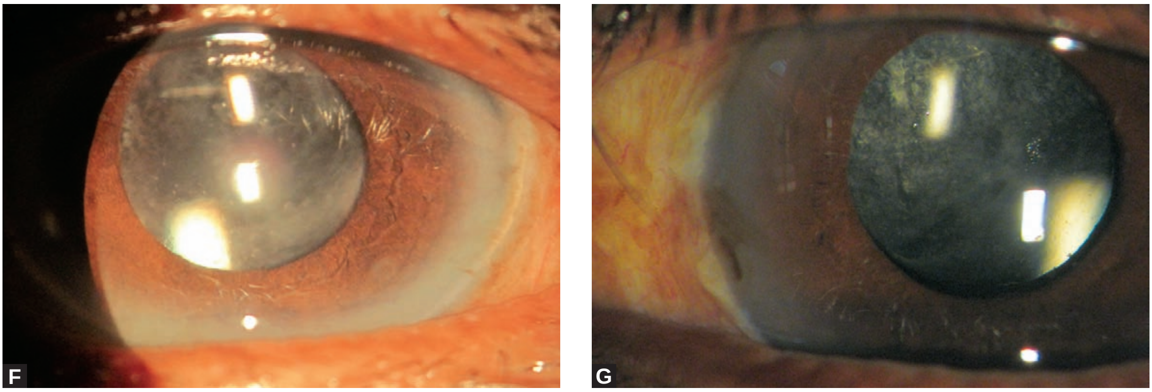


Fig. 4.3C: Pseudophakia with anterior chamber IOL



Figs 4.3D and E: Complications of cataract surgery: (D) Iris prolapse. *Note:* Pear shaped pupil with iris in the scleral wound; (E) Retained cortical matter. *Note:* White lens matter in the inferonasal quadrant with pseudophakia



Figs 4.3F and G: Posterior capsule opacification. *Note:* Membrane behind IOL

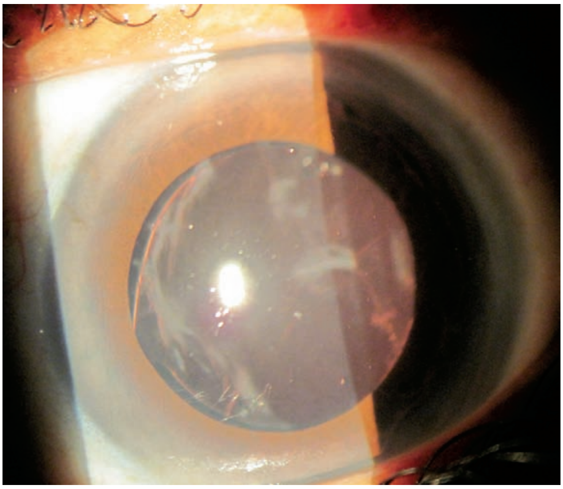


Fig. 4.3H: Posterior capsule opacification as seen in retroillumination

- Consecutive myopia—the power of the IOL is more than required
- Consecutive hypermetropia—the power of the IOL is less than required.

What is the Status of Near Vision of a Pseudophakic Eye?

All pseudophakic eyes require near vision correction unless multifocal IOL or accommodative IOL is placed or consecutive myopia is done by over correction, i.e. by implanting higher power IOL than required (Myopia-short sightedness, person can see near things clearly).

Name the Various Generation of IOLs

First generation:

- Posterior chamber IOL (Ridley's posterior chamber IOL)
- Sir Harold Ridley was the first to use IOL'S in cataract surgery.

Second generation: Anterior chamber angle fixated lenses.

Third generation: Iris supported lenses fourth generation: Modified one piece anterior chamber lenses.

Fifth generation: Modified posterior chamber lenses

Sixth generation: Modern capsular posterior chamber IOL and modern anterior chamber IOL.

What are the Recent Advances in IOLs?

- Multifocal IOLs
- Foldable IOLs.

What are the Materials IOLs Made of?

- PMMA—Polymethyl metha acrylate
- Silicone
- Acrylic
- Hydrogels.

What are the Parts of IOL?

IOL has got two parts optic and haptic.

What are the Types of IOLs?

Depending on the site where they are placed ***(Fig. 4.4)****.*

- Anterior chamber IOL
- Iris fixated IOL
- Posterior chamber IOL.

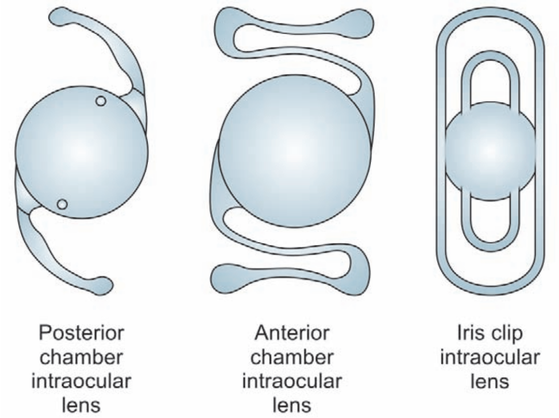

Posterior chamber intraocular lens
Anterior chamber intraocular lens
Iris clip intraocular lens

Fig. 4.4: Types of IOLs

Depending on Nature

- Rigid IOL
- Foldable IOL.

IOLs can be three piece IOL-optic and haptic made of different material or same material (optic and haptic are made separately later joined).

Single piece IOL-optic and haptic made of same material.

How IOLs are Sterilized

Chemical sterilization-soaking the lens in 10 percent sodium hydroxide solution

Gas sterilization-by exposing the lens to ethylene oxide.

Radiation sterilization-by exposing to Gamma rays up to 2.5 M rad.

What are the IOL Related Complications?

Malposition of IOLs ***(Fig. 4.5)***

- Decenteration
- Subluxation: Sunset syndrome-inferior subluxation

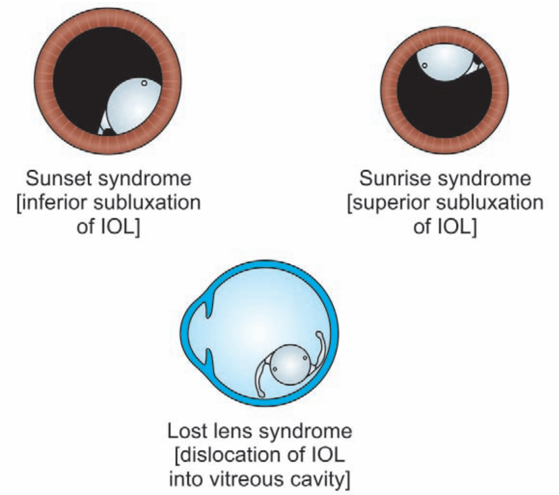

Sunset syndrome [inferior subluxation of IOL]
Sunrise syndrome [superior subluxation of IOL]
Lost lens syndrome [dislocation of IOL into vitreous cavity]

Fig. 4.5: Malposition of IOLs

Sunrise syndrome—Superior subluxation
- Dislocation: Lost lens syndrome-dislocation of IOL into vitreous chamber

Wind shield wiper syndrome: Movement of the IOL with movements of the eye as a result of small IOL placed in the ciliary sulcus.

Pupillary capture (Fig. 4.6): Formation of synechiae between the posterior surface of the optic and the underlying iris.

Iris tuck: Entrapment of peripheral iris between the IOL haptic and peripheral structures.

Other Complications of IOLs

UGH syndrome: Uveitis, glaucoma and hyphema because of mechanical rubbing of the iris on a sharp edge due to improper finishing quality of the IOL.

CRIS syndrome: (Corneal retinal inflammatory syndrome) constant IOL uveal contact and toxic material of the IOL leads to chronic inflammation.

Persistent corneal edema and corneal decompensation cystoid macular edema posterior capsular opacification.

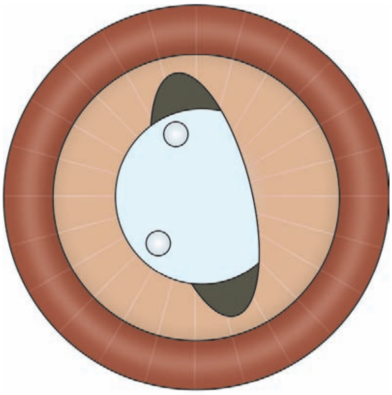


Fig. 4.6: Pupillary capture. *Note:* Optic of the IOL partly on the iris and rest behind the iris

Toxic lens syndrome: Uveitis caused by toxins associated with lens like ethylene gas used for sterilizing lens.

What are the Causes for Diminision of Vision in a Pseudophakic Eye?

After cataract and cystoid macular edema are the two most common causes for dimninsion of vision in pseudophakic eyes.

Failure to Identify Pre-existing Causes Before Surgery

- Pre-existing glaucoma
- Retinal diseases like diabetic maculopathy, age related macular degeneration, retinal detachment.
- Pre-existing amblyopia.

Early Postoperative Complications

- Corneal edema finally leading to bullous keratopathy
- Pseudophakic pupillary block glaucoma
- Endophthalmitis.

Late Postoperative Complications

- After cataract
- Cystoid macular edema
- Retinal detachment.

What is After Cataract?

- It is also called as PCO (Posterior capsule opacification)
- After cataract is opacification of posterior capsule of the lens following ECCE
- Incidence is 10–50 percent following ECCE

After cataract can never be seen in ICCE as lens is removed along with both anterior and posterior capsule.

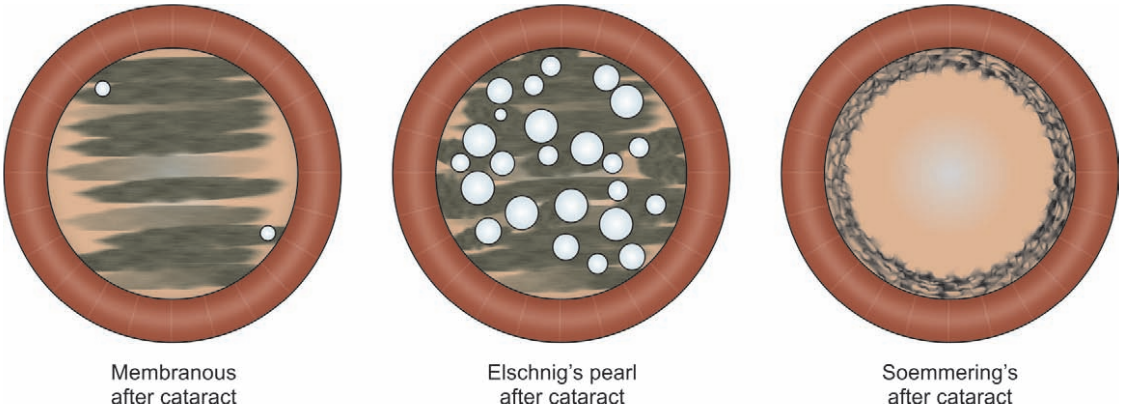


Fig. 4.7: Types of after cataracts

What are the Types of after Cataracts?

Membranous after cataract: Cells proliferate like membrane.
Elschnig's pearl: Cells proliferate and distend to form spherical cells.

Soemerring's ring: Cells proliferate and get enclosed between two layers lens capsule and appear like ring, hence seen at the periphery.

What is the Mechanism of After Cataract?

Epithelium of lens

Anterior epithelium which lie deep to anterior capsule equatorial epithelium at the equator region which are active through out life.
Posterior epithelium is absent as these cells are used up in development of lens during fetal life.

Reduce the stimulus for after cataract by:

Using biocompatible IOL to reduce stimulation of cellular proliferation.

Prevent the after cataract from reaching posterior capsule by:

Using IOL with square truncated edges which prevent migration of anterior epithelial cells posteriorly.

Using biconvex IOL or planoconvex IOL with convexity towards the posterior capsule and placing it in the capsular bag so that it obliterates the space between IOL and posterior capsule.

The equatorial epithelium which remains active through out life is the primary source of after cataract especially for Elschnig's pearl and soemerring's ring.

The membranous type of after cataract is because of posterior proliferation of anterior epithelium cells.

How After Cataract can be Prevented?

Reduce the source for after cataract by:

- Complete removal of cortical matter
- Polishing of the posterior capsule
- Polishing of the undersurface of the remaining anterior capsule to remove the anterior and equatorial epithelial cells

How After Cataract is Treated?

After cataract is treated by Nd-YAG capsulotomy where central part of the posterior capsule is removed by laser energy. Nd-YAG stands for neodymium yttrium aluminium garnet.

Dense membranous after cataract which cannot be removed by laser has to be treated by surgical posterior capsulotomy.

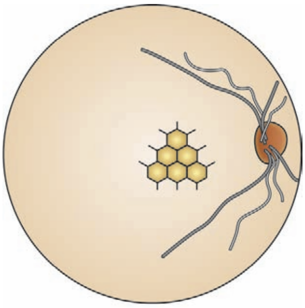


Fig. 4.8: Cystoid macular edema (Honeycomb appearance)

What is CME?

Cystoid macular edema

- It is the collection of fluid in the Henle's layer of macula in the form of cystic loculi
- On fundoscopy it gives typical honeycomb appearance **(Fig. 4.8)**.
- On fundus fluorescein angiography it gives flower petal appearance.

Anatomy of macula

In the macular region which surrounds the fovea centralis, the outer plexiform layer is thicker than elsewhere in the retina called Henle's layer.

In Fovea centralis rods are absent cones are tightly packed and other layers of retina are absent. It consists of cones and their nuclei covered by a thin internal limiting membrane.

The thinness of fovea centralis (provides little protection against inflammatory exudates that pass through vitreous) and the thickness of Henles layer (because of its thickness can absorb large quantities of fluid) are responsible for accumulation of inflammatory exudates at macular region.

What is the Mechanism of CME?

Release of inflammatory mediators, i.e. prostaglandins result in edema at macula. Inflammatory mediators are released due to:

- Postoperative inflammation because of iridocyclitis
- *Systemic factors:* Uncontrolled diabetes and hypertension
- Vitreous disturbances like vitreous loss vitreous incarceration in the wound.

How CME is Treated?

Prophylaxis is by preoperative and postoperative use of antiprostaglandins like flurbiprofen and by control of systemic diseases like diabetes mellitus and hypertension before surgery.

In cases of CME without vitreous disturbances control of inflammation with steroids and antiprostaglandins.

In cases of CME with vitreous disturbances anterior vitrectomy with steroids and antiprostaglandins.

APHAKIA

1. *Biodata:*
   Here is a male/female patient aged about .... years, ... by occupation, from........
2. *Presenting Complaints:*
   Diminision of vision in RE/LE/BE for far and near which improves with spectacles with H/O cataract surgery to RE/LE/BE.

Reasons for poor vision in aphakia

Since in aphakia lens is removed, the power of the eye is reduced by +16D(D-diopters) (from +60D in normal eye to +44D in aphakic eye), hence the eye becomes highly hypermetropic causing diminision of vision for far and near.

Vision in aphakia without correction by spectacles is approximately about 3/60(counting fingers 3 meters).

3. *History of Presenting Illness:*
   He/She gives history of cataract surgery .... months/years back. He/She noticed diminision of vision in RE/LE/BE after surgery for distance and near which improved with spectacles.

History regarding trauma and spontaneous dislocation has to be enquired if there is no history of cataract surgery.
Spontaneous dislocation of lens which may occur in hypermature cataract may cause improvement in vision spontaneously from hand movements + (vision in hypermature cataract) to counting fingers up to 3 meters (vision in aphakia without spectacles) without history of cataract surgery.

Causes for aphakia

Surgical: After cataract surgery.
Trauma: Traumatic extrusion of lens.
Dislocation: Posterior dislocation of lens spontaneously or following trauma.
Congenital: Absence of lens very rarely.
Surgical aphakia is the most common cause of aphakia.

Causes for diminision of vision in aphakia with spectacles

- Cystoid macular edema
- Retinal detachment
- Aphakic glaucoma
- Astigmatism induced by surgery
- Aphakic bullous keratopathy.

4. *Ocular history:*
   He/She is/was wearing spectacles for
   - Near vision
   - Distance vision (choose one among three)
   - Both.

   He/She gives H/O cataract surgery.
5. *Past history:*
   He/She is a known diabetic on treatment/not a known diabetic.
   He/She is a known hypertensive on treatment/not a known hypertensive.
6. *Family history:* Significant/not significant
7. *Personal history:*
   - Diet
   - Appetite
   - Habits.
8. *Socioeconomic history:*

DIAGNOSIS OF APHAKIA

History

H/O cataract surgery or history of trauma or history of spontaneous dislocation.

Visual Acuity

- Vision without spectacles up to counting fingers 3 meters
- Vision with spectacles (with + 10D) improvement in vision

- Retinoscopy shows hypermetropic refractive error.

Ocular Examination

- Limbal scar (scar of previous cataract surgery seen in surgical aphakia).
- Anterior chamber is deep and iridodonesis is present i.e. tremulousness of iris because of lack of posterior support.
- Jet black color of the pupil.
- *Purkinje's images:* Only two are present. (third and fourth because anterior capsule and posterior capsule both are absent)

CASE DISCUSSION

Aphakia

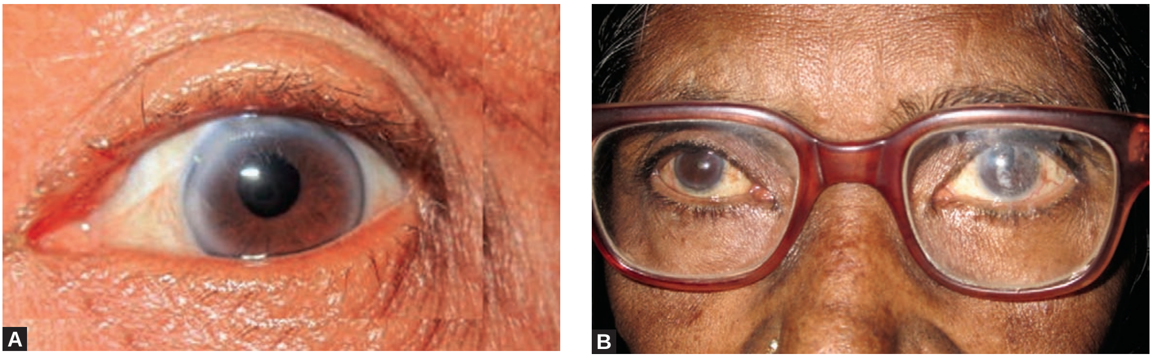
Aphakia is a defined as a condition in which lens is absent from its normal position, i.e. from pupillary area (patellar fossa).

Aphakia literally means absence of lens from the eye **(Figs 4.9A to D)**.

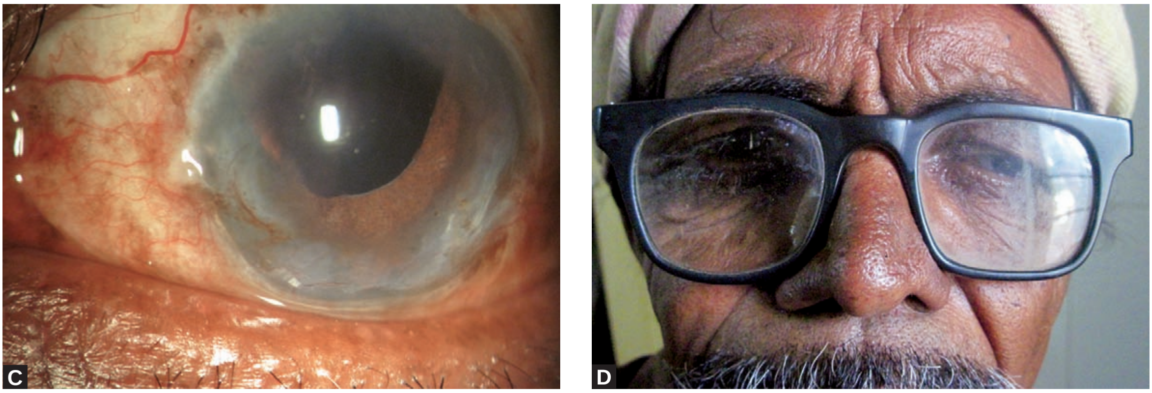
Phakia means lens

Aphakia means absence of lens from its normal position.

Pseudophakia means presence of artificial lens in the eye.



Figs 4.9A and B: (A) Aphakia. *Note:* Jet black pupil and absence of shining reflexes; (B) Aphakic patient wearing aphakic glasses for her left eye. Aphakic glass is thick in the center and produces magnification of the image



Figs 4.9C and D: (C) Aphakia. *Note:* U shaped pupil commonly due to sectoral iridectomy; (D) Aphakic patient wearing aphakic glasses for his left eye.

Describe the Optics of Aphakia

If the eye was emmetropic earlier it becomes highly hypermetropic as the total power of the eye is reduced from +60D to + 44D.

The anterior focal distance is 23 mm (normally 15 mm) and posterior focal distance is 31 mm (normally 24 mm).

Accommodation is totally lost due to absence of lens.

Describe the Treatment of Aphakia

Aphakia is corrected by convex lenses of appropriate power to correct hypermetropia

- Spectacles
- Contact lenses
- Intraocular lens implantation
- Refractive corneal surgery like hypermetropic lasik.

Spectacles for aphakia

Approximately + 10D spherical convex lens

+

Cylindrical lenses for correction of surgically induced astigmatism

+

+3D of convex spherical lens addition for near vision

The above mentioned is for previously emmetropic eyes. In patients with ammetropia, power has to be calculated by doing refraction.

What are the Advantages and Disadvantages of Aphakic Glasses?

Advantages:

Cheap and easy method of correcting aphakia.

Disadvantages:

- The glasses are very thick and heavy hence cause cosmetic disfigurement and inconvenience to use them.
- Image magnification of about 30 percent.
- Prismatic aberration producing roving ring scotoma also called jack in the box phenomenon.
- Spherical aberration producing pin cushion distortion.
- Reduced field of vision.
- Anisometropia if the other eye is normal or pseudophakic.

Roving ring scotoma

A ring scotoma produced by the prismatic effect at the periphery of the thick convex lens which moves against the movement of the eye.

Since this scotoma shifts with the movement of the eyes, the scotoma appears and disappears with the changing position of the eyes from object to object. This is called jack in the box phenomenon.

What are the Advantages and Disadvantages of Correction of Aphakia with Contact Lenses?

Advantages:

- Cosmetically gives better acceptance
- Image magnification is less,about 8 percent spherical and prismatic aberrations are not present
- Wider field of vision.

Disadvantages:

- Costlier than spectacles
- Requires care and maintainence of contact lenses
- Contact lens intolerance
- Contact lens complications like gaint papillary conjunctivitis, corneal abrasion, microbial keratitis, corneal wraping, superficial punctate keratitis.

What are the Advantages and Disadvantages of Correction of Aphakia with Intraocular Lens?

Advantages:

- Best method to correct aphakia
- Will not have disadvantages associated with aphakic glasses
- Anisometropia is not seen if the other eye is normal or pseudophakic.

Disadvantages: Requires one more surgery, hence complications associated with cataract surgery can be seen.

Case 1: A patient with aphakia in one eye and the other eye being pseudophakia or normal. What is the preferred modality of correction of aphakia?

Spectacles are not preferred, because it will cause anisometropia. Anisometropia is a refractive condition in which the refraction of the two eyes is unequal. A difference of more than 2.5D is not tolerated causing diplopia. Contact lens correction is possible. Intraocular lens correction is the best and preferred method.

Case 2: A patient with aphakia in right eye and immature/mature cataract in left eye. What is the preferred treatment. Treatment options are:

a. Cataract surgery in left eye without IOL implantation, i.e. making the eye aphakic and later giving aphakic correction to both eyes so that anisometropia is avoided.
   Though bilateral aphakia will not cause anisometropia this treatment is not preferred because of disadvantages associated with aphakic spectacles.
b. Cataract surgery in the left eye with posterior chamber IOL implantation followed by secondary IOL implantation in right eye. This is the preferred treatment.

What is Secondary IOL implantation?

It is defined as insertion of IOL into an eye which is rendered aphakic by prior cataract extraction.

Secondary IOL implantation

After ICCE

- Anterior chamber IOL implantation
- Iris fixated IOL implantation
- Scleral fixated IOL.

After ECCE

With intact posterior capsule

- Posterior chamber IOL

Without posterior capsule support

- Anterior chamber IOL implantation
- Iris fixated IOL implantation
- Scleral fixated IOL.

What are the Causes for Surgical Aphakia?

- Intracapsular cataract extraction
- Operative complications during extracapsular cataract extraction like posterior capsule rent with vitreous loss.

What are the Complication of Aphakia?

- Cystoid macular edema
- Retinal detachment incidence is higher in aphakics because of associated vitreous loss and vitreous traction
- Vitreous touch syndrome-vitreous touch, bullous keratopathy and cystoid macular edema (Irvine Gass syndrome)
- Aphakic bullous keratopathy
- Aphakic glaucoma.

CORNEAL OPACITY

1. *Biodata:*
   Here is a male/female patient aged about ………… years, ………… by occupation, from…………
2. *Presenting Complaints:*
   His presenting complaints are:
   White opacity in RE/LE/BE since ………… ………… months/years
   Diminision of vision in RE/LE/BE since ………… months/years.
3. *History of Presenting Illness:*
   He/She was apparently normal ………… months/years back. He/She noticed white opacity in RE/LE/BE insidious/sudden in onset gradually progressive/stationary in nature after trauma/corneal ulcer/congenital.

Causes of corneal opacity

Congenital:

S—sclerocornea
T—tears in Descemet's membrane
U—ulcer
M—metabolic conditions like mucolipidosis, mucopolysaccharidosis
P—posterior corneal defect like Peter's anomaly
E—endothelial dystrophy like congenital hereditary endothelial dystrophy
D—dermoid

Acquired:

- Post-trauma following chemical injuries, mechanical injuries
- Corneal degenerations
- Post infection or inflammation of cornea following infective or noninfective keratitis.

Opacity is associated/not associated with

- Diminision of vision
- Glare
- Pain
- Redness
- Watering

Corneal opacity in the periphery will not cause any visual problems.

Corneal opacity in the visual axis will cause diminision of vision.

Nebular and macular grade corneal opacity cause diminision of vision by causing glare and irregular astigmatism.

Leucomatous grade corneal opacity causes diminision of vision by completely obstructing the light rays.

Corneal opacity is the end result of any form of insult/disease of cornea. Since corneal opacity is not an active disease it is not associated with symptoms like pain and redness.

4. *Ocular history:*
   He/She is/was wearing spectacles for
   - Near vision
   - Distance vision (choose one among three)
   - Both.

   He/She gives history of surgery/no history of surgery to RE/LE/BE.
5. *Past history:*
   He/She is a known diabetic on treatment / not a known diabetic.
   He/She is a known hypertensive on treatment /not a known hypertensive.
   He/She is a known patient of COPD, asthma, Ischemic heart disease on treatment/not a known patient of COPD, asthma, ischaemic heart disease.
   He/She gives past history of tuberculosis/ no past history of tuberculosis.
6. *Family history:* Significant/not significant
7. *Personal history:*
   Diet
   Appetite
   Habits
8. *Socioeconomic history:*
   He/She belongs to
   - Upper class
   - Middle class
   - Lower class.

Corneal opacity is more common in low socioeconomic status
- Because of more incidence of trauma
- Particularly in children because of deficiency of vitamins, e.g. Vitamin A deficiency causing keratomalacia.

OCULAR EXAMINATION

Corneal opacity is examined under the following headings:

- Position of corneal opacity in relation to the limbus and pupil
- *Number:* Can be single or multiple
- *Shape:* It varies according to cause of corneal opacity
- *Size:* It varies according to cause of corneal opacity.
- Depth and grading of opacity:
- *Staining of opacity:* Corneal opacity will not stain with dyes like fluorescein since epithelium is intact in corneal opacity.
- Vascularization of opacity
- Iris incarceration in opacity
- *Corneal sensation:* It will be absent in corneal opacity.

- Normal cornea is avascular except for peripheral 1 mm.
- Vascularization of cornea is always pathological.
- It can be superficial or deep vascularization.
- Superficial corneal vascularization causes trachoma, phlyctenular keratoconjunctivitis
- It is bright red in color, located at subepithelial level and their continuity can be traced with conjunctival vessels.
- Deep corneal vascularization: causes:interstitial keratitis, disciform keratitis.
- It is purple in color located at the stromal level and the vessels here are derived from anterior ciliary arteries and there is a clear zone at the limbus their continuity cannot be traced beyond limbus.

Diminished corneal sensation

Congenital: Congenital trigeminal anesthesia, congenital corneal hyposthesia

Pharmacological: Local anesthetics like xylocaine

Pathological

Ocular: Viral infections of cornea like herpes simplex, corneal degenerations and dystrophies

Systemic: leprosy, diabetes…

Post-trauma/surgical: Corneal scars, keratoplasty, refractive surgery.

Define Corneal Opacity

- Corneal opacity literally means loss of transparency of cornea.
- Loss of transparency of cornea due to scarring is called corneal opacity.

Name the Factors Responsible for Transparency of Cornea

- Regular arrangement of corneal lamellae
- Avascularization
- Relative state of dehydration maintained by barrier effects of epithelium and endothelium.

What are the Causes for Loss of Corneal Transparency?

- Corneal edema
- Corneal dystrophies
- Corneal degenerations
- Inflammations of cornea
- Vascularization of cornea
- Scarring of cornea.

What are the Causes for Corneal Opacity?

Congenital:

S— sclerocornea
T— tears in Descemet's membrane
U—ulcer
M—metabolic conditions like mucolipidosis, mucopolysaccharidosis

P— posterior corneal defect like Peter's anomaly
E— endothelial dystrophy like congenital hereditary endothelial dystrophy
D—dermoid

Acquired:

- Post-trauma following chemical injuries mechanical injuries
- Corneal degenerations
- Post infection or inflammation of cornea following infective or non infective keratitis

What are the Grades of Corneal Opacity?

Nebular grade corneal opacity: It is faint corneal opacity due to scars involving Bowman's layer and superficial stroma.

Macular grade corneal opacity: It is a semidense corneal opacity due to scars involving half of the corneal stroma.

Leucomatous grade corneal opacity: It is a dense corneal opacity due to scars involving more than half of the stroma.

Adherent leucoma: It is a leucomatous corneal opacity with incarceration of iris into the leucomatous corneal opacity.

> A small nebular grade corneal opacity in the visual axis will cause more visual discomfort than a small leucomatous opacity because nebular corneal opacity causes diffraction of light resulting in glare where as leucomatous opacity just obstructs all the light in its path.

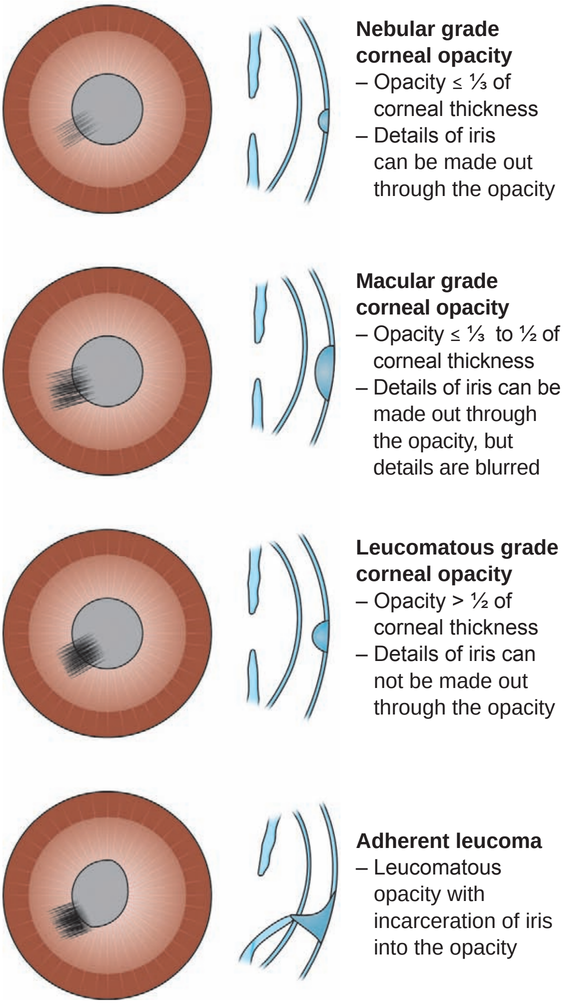

Nebular grade corneal opacity
– Opacity ≤ ⅓ of corneal thickness
– Details of iris can be made out through the opacity
Macular grade corneal opacity
– Opacity ≤ ⅓ to ½ of corneal thickness
– Details of iris can be made out through the opacity, but details are blurred
Leucomatous grade corneal opacity
– Opacity > ½ of corneal thickness
– Details of iris can not be made out through the opacity
Adherent leucoma
– Leucomatous opacity with incarceration of iris into the opacity

Fig. 4.10: Grades of corneal opacity

What is Staphyloma?

- The word staphyloma means bunch of grapes
- Localized bulging of the weak and thin outer layer of the eyeball, cornea or sclera lined by uveal tissue.

What are the Types of Staphyloma?

- Anterior staphyloma
- Intercalary staphyloma
- Ciliary staphyloma
- Equatorial staphyloma
- Posterior staphyloma.

What is the Treatment for Corneal Opacity?

Corneal opacity in the periphery will not cause any visual problems and hence does not require any treatment.

Treatment for Corneal Opacity with Good Visual Prognosis:

For diffuse corneal opacities:

- Nebular grade corneal opacity can be treated by photo therapeutic keratectomy (PTK)
- Macular grade corneal opacity can be treated by Lamellar Keratoplasty
- Leucomatous grade corneal opacity require deep anterior lamellar keratoplasty (DALK) or penetrating keratoplasty(PK).

For localized central opacities:

Optical iridectomy: To improve vision by enlarging the size of the pupil to allow light rays from peripheral clear cornea.

Rotational autograft: The scarred cornea along with clear cornea surrounding it is trephined and is sutured back to the same cornea by rotating it so that opaque cornea directs away from the visual axis.

Treatment for Corneal Opacity with no Visual Prognosis:

Tattooing of corneal opacity using 4 percent gold chloride or 2 percent platinum chloride.

Penetrating keratoplasty for cosmetic purpose only.

What is Keratoplasty?

Synonyms: Corneal grafting, corneal transplantation

Replacement of diseased patient's cornea by donor's healthy clear cornea is called keratoplasty.

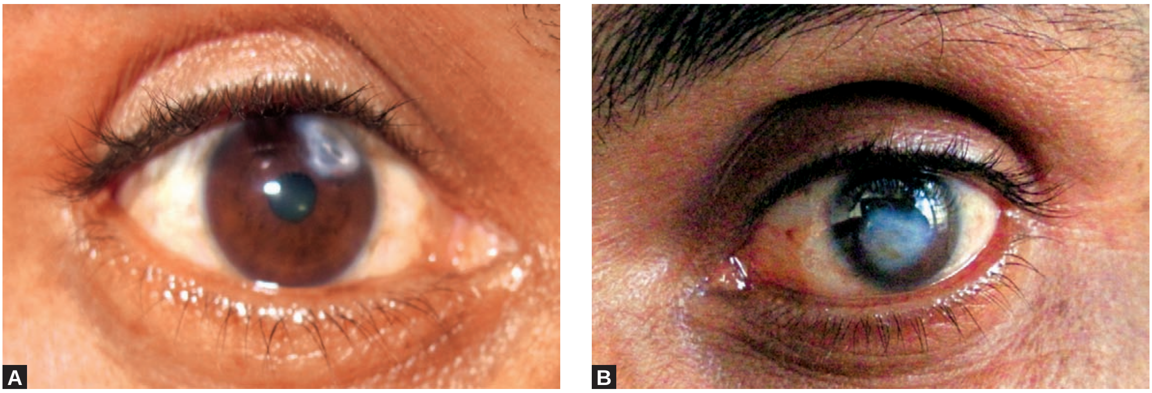
What are the Types of Keratoplasty?

- Full thickness—penetrating keratoplasty(full thickness of cornea is transplanted)
- Partial thickness—Lamellar keratoplasty.

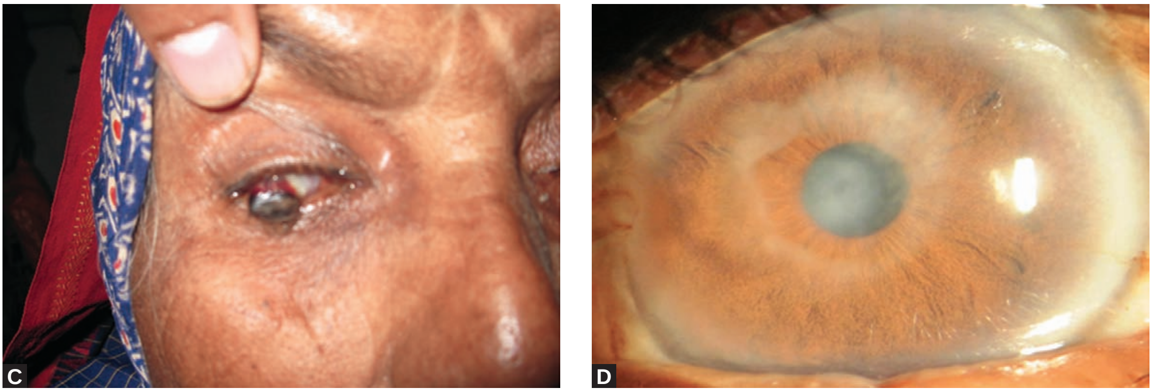
In lamellar keratoplasty one or two layers of cornea (stroma and endothelium or only endothelium) are transplanted.

In deep anterior lamellar keratoplasty (DALK) except endothelium and Descemet's membrane rest of the cornea is transplanted in diseases where endothelium is not affected like stromal dystrophies,macular grade corneal opacities.

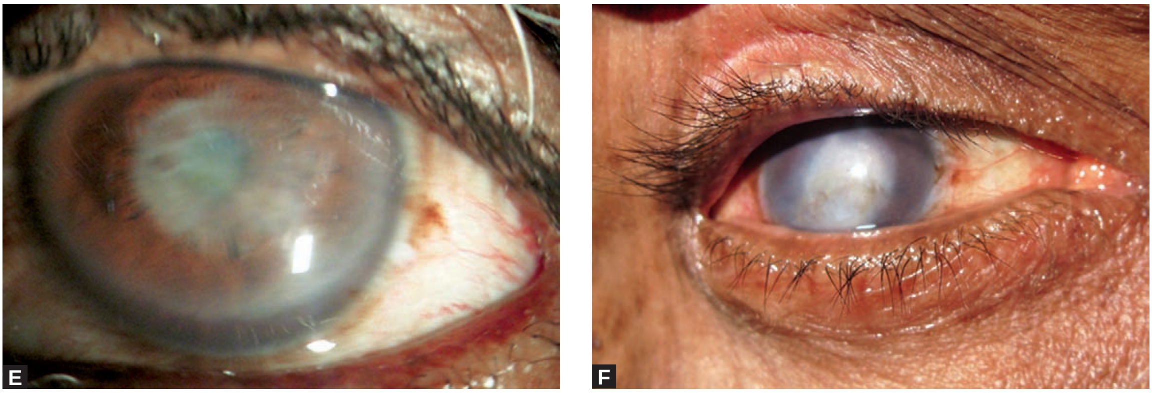
In descemet's strippling endothelial keratoplasty (DSEK) and deep lamellar endothelial keratoplasty (DLEK) only endothelium is transplanted. It is done in diseases involving only endothelium like endothelial dystrophies.



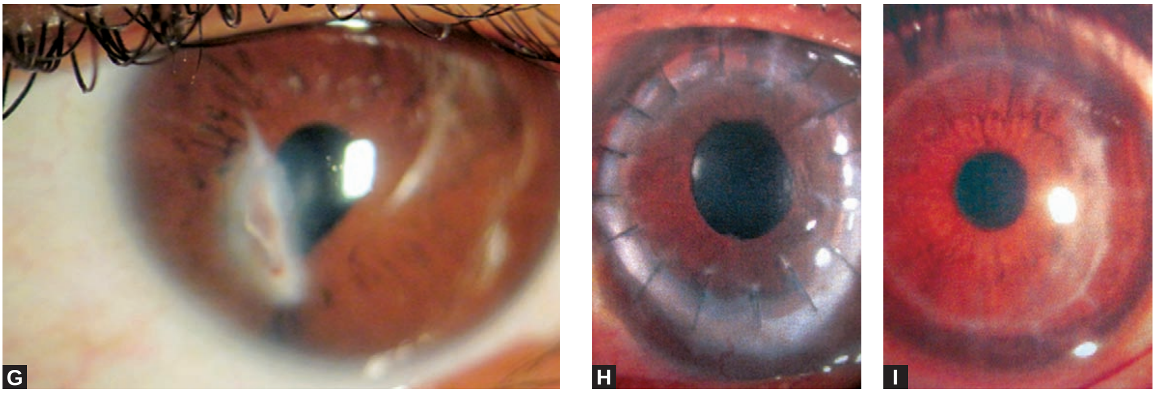
Figs 4.11A and B: Peripheral leucomatous grade corneal opacity; (B) Central leucomatous grade corneal opacity



Figs 4.11C and D: (C) Anterior staphyloma; (D) Leucomatous grade corneal opacity



Figs 4.11E and F: (E) Macular grade corneal opacity; (F) Leucomatous grade corneal opacity



Figs 4.11G to I: (G) Adherent leucoma; (H and I) Post keratoplasty before suture removal; After suture removal. *Note:* Incarceration of iris in the corneal opacity making the pupil irregular

Indications for keratoplasty

Optical keratoplasty: Done for improvement of vision, e.g. corneal opacity, corneal dystrophies. Therapeutic keratoplasty: Done as a part of treatment, e.g. to treat nonhealing corneal ulcer which may ultimately end in perforation.
Tectonic keratoplasty: Done to restore integrity of eyeball, e.g. after perforation of corneal ulcer *cosmetic keratoplasty:* Done for cosmetic purpose only without any visual prognosis

The donor eye has to be removed within 6 hours of death.

Methods of corneal preservation

Short-term storage: up to 48 hours

- Moist chamber method
- McCarey-Kaufman medium

Intermediate term storage: up to 2 weeks

- K-sol medium
- Dexol medium
- Optisol medium
- Corneal storage medium.

Long-term storage:

- Organ culture method up to 35 days
- Cryopreservation for indefinite period of time.

Complications of keratoplasty

- Graft failure-irreversible corneal edema
- Graft rejection-type 4 immunological reaction by the host against the donor cornea
- Graft infection
- Astigmatism induced by surgery.

Contraindications for use of donor eye

Ocular: Intrinsic eye diseases like intraocular tumors, corneal opacity.
Systemic:

- Conditions potentially hazardous to eye bank personnel if transmitted, like AIDS or HIV sero-positivity, Rabies, Creutzfeldt Jakob disease, viral hepatitis.
- Death from unknown cause
- Septicemia
- Malignancies like leukemia, lymphoma.

ADULT DACRYOCYSTITIS

1. *Biodata:*

   Here is a male/female patient aged about .... years, ... by occupation, hailing from ....

Important facts:

Age: Adult dacryocystitis is more common between 40 to 60 years.

Sex: It is more common in females due to comparatively narrow lumen of the bony canal (nasolacrimal duct).

2. *Presenting Complaints:*

   His/Her presenting complaints are

   Watering in RE/LE/BE since .... months/years.

If swelling is present it should be included in presenting complaints.

If watering is associated with pain and redness of eye as in acute dacryocystitis, they have to be included in presenting complaints and the same has to be described in history of presenting illness.

3. *History of Presenting Illness:*

   He/She was apparently normal .... months/years back. He/She noticed

   Watering in RE/LE/BE since .... months/years.

   Associated with swelling in the lacrimal sac region, i.e. medial-to-medial canthus. Associated with discharge (mucoid/mucopurulent/purulent).

   Associated with/without recurrent episodes of pain, redness.. (to rule out epi sodes of inflammation).

4. *Ocular history:*

   He/She gives history of surgery/no history of surgery to RE/LE/BE for complaints of watering.

   He/She gives history of trauma/no history of trauma to RE/LE/BE.

After dacryocystectomy (DCT) patient will have watering as lacrimal sac is totally removed and no longer tears can be drained via nasolacrimal duct.

Trauma involving lacrimal drainage system like canalicular tear, eversion of punctum because of cicatricial ectropion can result in watering as tears are no longer drained by lacrimal drainage system.

5. *Past history:* History of similar complaints may be present in past in case chronic dacryocystitis and in cases of recurrent dacryocystitis due to failure of treatment i.e. following failed DCR.

   He/She is a known diabetic on treatment/not a known diabetic.

   He/She is a known hypertensive on treatment/not a known hypertensive.
6. *Family history:* Significant/not significant
7. *Personal history*
8. *Socioeconomic history:*

   He/She belongs to
   - Upper class
   - Middle class
   - Lower class

It is more common in low socioeconomic group because of poor personal hygiene which may act as predisposing factor.

Ocular Examination

Inspection

- Look for watering of the eye
- The eye appears wet with accumulation of tears at the medial canthus. There may be discharge at the medial canthus. The conjunctiva may show congestion indicating chronic dacryocystitis
- Look for any swelling over lacrimal sac area, if there is a swelling the swelling has to be described under:
  - Site
  - Size

  - Shape
  - Surface
  - Skin over the swelling
- Look for any surgical scar seen in cases of DCT or DCR
- Look for any evidence of trauma in the form of irregular scar over the lacrimal drainage system or cicatrical ectropion
- Look for any fistula over the lacrimal sac area

Palpation

- Presence of tenderness which indicates whether the swelling is acute or chronic
- Regurgitation test **(Fig. 4.12C)**.

Diagnosis

Acute dacryocystitis: **(Fig. 4.12A)** H/O watering and discharge associated with a painful swelling in the lacrimal sac area.

Chronic dacryocystitis: **(Fig. 4.12B)** H/O watering with or without mucoid discharge. It may or may not be associated with painless swelling in lacrimal sac area.

Differential diagnosis:

1. Hyper lacrimation caused by reflex lacrimal hyper secretion secondary to ocular inflammations like conjunctivitis, keratitis....
2. Epiphora due to obstruction of lacrimal drainage system.
   Chronic dacryocystitis is the most common cause for epiphora.

Approach to a patient with watering

Rule out any cause of reflex hyper lacrimation due to

- Diseases of eyelids like trichiasis, concretion, entropion, hordeolum of conjunctiva like conjunctivitis
- Diseases of cornea like keratitis
- Diseases of sclera like scleritis
- Diseases of uvea like uveitis
- Regurgitation test
- Fluorescein dye disappearance test
- Lacrimal syringing
- Jones dye tests
- Dacryocystography and radionucleotide dacryocystography.

What is Dacryocystitis?

- Inflammation of lacrimal sac is called dacryocystitis
- It can be congenital or acquired
- Acquired variety can be acute or chronic.

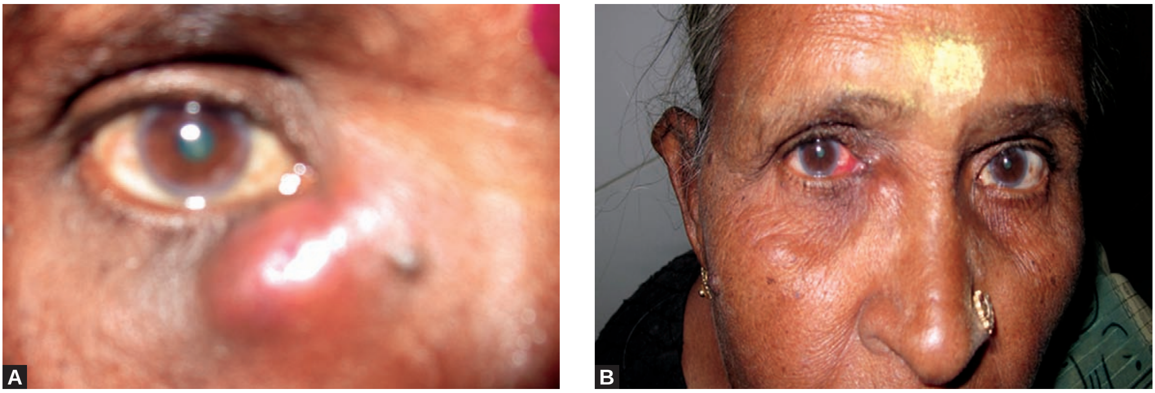


Fig. 4.12A and B: (A) Acute dacryocystitis. *Note:* The presence of inflammatory signs i.e. redness over lacrimal sac area; (B) Chronic dacryocystitis

What are the Causative Organisms for Chronic Dacryocystitis?

Staphylococcus aureus, Pneumococci, Streptococci, *Pseudomona*s are the common causative organisms. Rarely Tuberculosis, Syphilis, *Actinomyces israelii* and fungi like *Candida albicans* may also cause dacryocystitis.

What are the Stages of Chronic Dacryocystitis?

- Stage of chronic catarrhal dacryocystitis
- Stage of lacrimal mucocele
- Stage of chronic suppurative dacryocystitis
- Stage of chronic fibrotic sac.

What are the Stages of Acute Dacryocystitis?

- Stage of cellulitis
- Stage of lacrimal abscess **(Fig. 4.12D)**
- Stage of fistula formation

What are the Complications of Chronic Dacryocystitis?

- Acute exaceberations resulting in acute dacryocystitis
- Chronic intractable conjunctivitis
- Risk of endophthalmitis if any intraocular surgery is performed in the presence of dacryocystitis

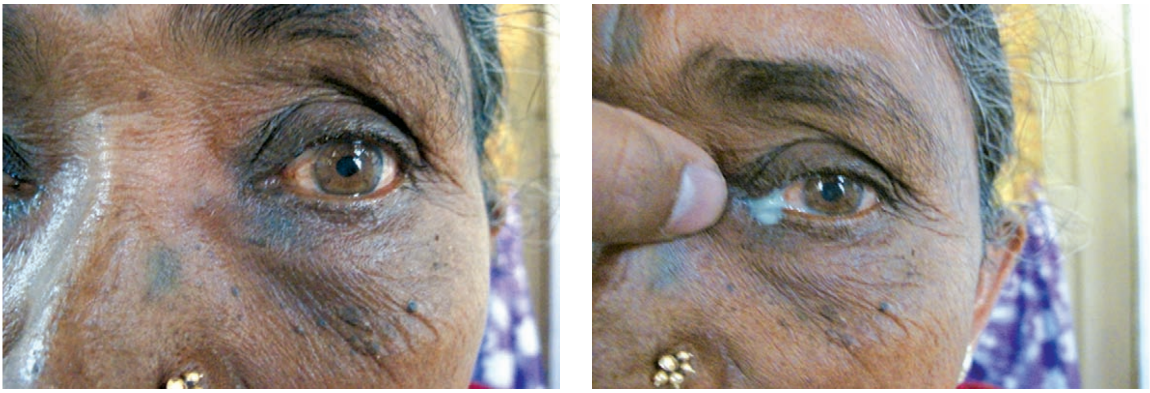


Fig. 4.12C: Regurgitation test. *Note:* Regurgitation of mucoid fluid on applying pressure over lacrimal sac area with thumb of the examiner

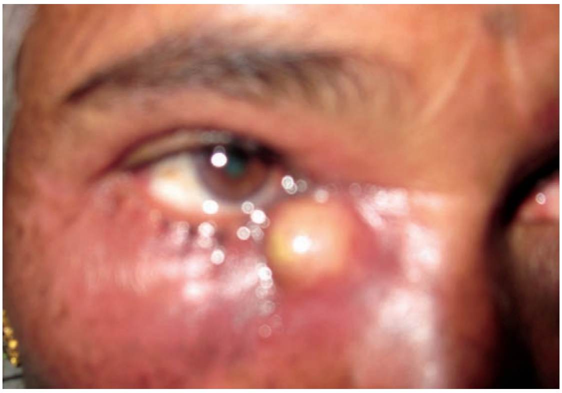


Fig. 4.12D: Acute dacryocystitis with pyocele

- Simple corneal abrasion may become infected leading to the development of corneal ulcer in the presence of chronic dacryocystitis.

Regurgitation test

Apply pressure over the lacrimal sac area with either thumb or index finger.

Interpretation: In chronic dacryocystitis the contents of the sac shall regurgitate through the lower or lower and upper punctum.

In chronic dacryocystitis with functional block, i.e. pump failure the contents of the sac shall empty in the nose.

In chronic dacryocystitis with encysted mucocele there is no regurgitation of the contents **(Fig. 4.12C)**.

Lacrimal syringing test

It is done by injecting saline into lacrimal drainage system with a lacrimal cannula fixed to a syringe filled with saline.

It is done to know the patency of lacrimal drainage system.

Procedure: It is performed under topical anesthesia with 4 percent xylocaine. Normal saline is pushed into the lacrimal sac from lower or upper punctum with a lacrimal cannula fixed to syringe filled with saline.

Interpretation:

Saline passes into throat freely as seen by swallowing reflex (by examiner) and appreciation of taste by patient. (Saline is used as it is easy to appreciate the saltish taste).

Fast regurgitation of clear fluid from same punctum in obstruction in same canaliculi.

Fast regurgitation of clear fluid from opposite punctum in obstruction at common canalicular junction.

Slow regurgitation of mucoid/mucopurulent fluid from same and opposite punctum in obstruction at lacrimal sac and nasolacrimal duct.

What is Hard Stop and Soft Stop?

It is the type of resistance seen during lacrimal syringing by the lacrimal cannula or during probing by a lacrimal probe.

If cannula/probe enters the sac, it comes to a stop at medial wall of the sac and the lacrimal bone is felt hard— Hard stop.

Hard stop excludes obstruction of canaliculi and common canalicular junction.

But if the cannula/probe stops proximal to the junction of common canaliculus and lacrimal sac, i.e. at lateral wall of the sac, there will be spongy feeling because cannula/probe presses the soft tissue of common canaliculus, lateral wall, and the medial wall of the sac before touching the bone behind—Soft stop.

Soft stop indicates that the block is at the level of common canalicular junction **(Fig. 4.13)**.

Fluorescein dye disappearance test

Two drops of 2 percent fluorescein drops are instilled into conjunctival fornices and observation is made after 2 minutes. Normally no dye is seen in conjunctival sac after 2 minutes.

Prolonged retention of dye in conjunctival sac indicates epiphora.

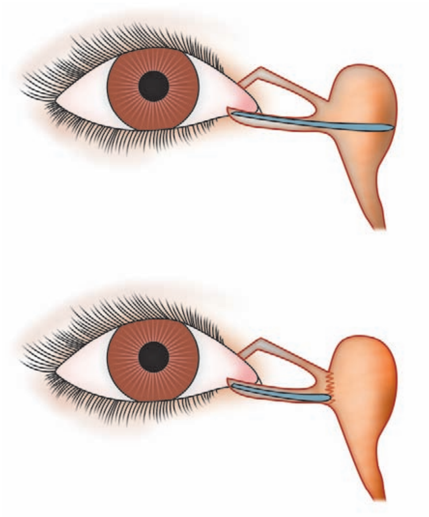


Fig. 4.13: Hard stop (Probe stopping at the medial wall of lacrimal sac and lacrimal bone); Soft stop (Probe stopping proximal to common canalicular junction due to common canalicular clock)

JONES dye tests

Jones dye tests are performed to differentiate partial obstruction and lacrimal pump failure.

Jones test I: Two drops of 2 percent fluorescein dye are instilled into the conjunctival sac and a cotton bud dipped in xylocaine is placed in the inferior meatus. After 5 minutes the cotton bud is inspected for staining with dye. Cotton bud stained with dye indicates that lacrimal passage is patent and the cause of watering is hyperlacrimation.

Jones test II: When first test is negative lacrimal syringing is performed. A positive test now suggests that dye was present in the sac could not reach the nose because of partial obstruction. A negative test again indicates lacrimal pump failure.

Dacryocystography

This test determines the site, nature and extent of block.

Technique: The inferior puncta are dilated with a nettleship punctum dilator.

Plastic catheters are inserted into inferior canaliculus on either side.

Contrast medium such as pentopaque, dianosil conray-280 or lipoidol is simultaneously injected on both sides and X-rays of PA view are taken after 5 minutes and 30 minutes to visualize the entire passage.

Interpretation:

- Failure of dye to reach the nose implies anatomical obstruction
- A normal dacryocystogram in the presence of epiphora indicates either partial obstruction or lacrimal pump failure.

Treatment of acute dacryocystitis

Treatment is mainly conservative by treating the acute infection by topical and oral broad spectrum antibiotics.

Pain relief by oral analgesics and hot fomentation.

In the stage of lacrimal abscess the above measures are combined with incision and drainage of the abscess.

Once the acute inflammation subsides depending upon the condition either DCT OR DCR operation is performed.

Treatment of chronic dacryocystitis

It is mainly surgical

Chronic dacryocystitis with NLD block or block in the lacrimal sac
- Dacryocystorhinostomy (DCR)

Chronic dacryocystitis with common canalicular block
- Canaliculocystorhinostomy

Chronic dacryocystitis with block in the canaliculi
- Conjunctivocanaliculocystorhinostomy
- Insertion of Lister's Jones Tube

Chronic dacryocystitis with external fistula
- Fistulectomy with dacryocystorhinostomy

DACRYOCYSTECTOMY (DCT)

Complete removal of lacrimal sac Indications:

1. Elderly, debilitated patient with shrunken and fibrosed sac.
2. Tumors or chronic granulomatous inflammations of sac like tuberculosis where sac has to be removed.
3. Nasal contraindications like atrophic rhinitis. Dacryocystectomy leaves the patient with watering for the rest of his life as the entire sac is removed but it prevents recurrent infections thus making the eye safe for any intraocular surgeries.

DACRYOCYSTORHINOSTOMY (DCR)

Surgical procedure which reestablishes the lacrimal drainage by connecting lacrimal sac to middle meatus of nose by making an ostium between lacrimal sac and nose (made by removing the lacrimal bone).

Indications:

DCR is the surgery of choice except for the indications mentioned in DCT.

TYPES OF DCR

Lacrimal sac can be approached by 3 routes

- Through canaliculi-canalicular DCR (LASER DCR)
- Through skin over lacrimal sac area-External DCR
- Through nose-nasal DCR (ENDONASAL DCR).

What are the Steps of DCR?

Anesthesia: General Anesthesia/Local Anesthesia.

Anesthesia for DCR

- Local skin injection for skin incision
- Infratrochlear nerve block by inserting needle below trochlea
- Infraorbital nerve block by inserting the needle at the junction of inferior orbital margin with anterior lacrimal crest
- Anesthesia of nasal mucosa by packing nose with a guaze piece moistened with lignocaine.

- *Nasal package:* Nose is packed with sterile ribbon gauze soaked in 2 percent lignocaine with 1:200000 adrenaline.
- A straight vertical or slightly curved incision is made within 3 mm or more than 8 mm medial to the inner canthus to avoid damage to angular vein.
- Skin and fibers of orbicularis oculi are dissected to expose medial palpebral ligament. Below the medial palpebral ligament lies the lacrimal sac. Lacrimal sac is separated from medial wall and floor to expose the lacrimal fossa. The anterior lacrimal crest and the bone from the lacrimal fossa are removed.
- A probe is introduced into the lacrimal sac through the lower canaliculus and the sac is incised in an H shaped manner to create two flaps.
- A vertical incision is made in the nasal mucosa to create anterior and posterior flaps.
- The posterior flaps and anterior flaps are sutured respectively.
- The medial canthal tendon is resutured to periosteum and the skin incision closed with interruptured sutures.

  Reults: Success rate is 90 percent.

What are the Complications of DCR?

Hemorrhage from injury to angular vein or nasal mucosa is the most common intraoperative complication.

Blockage of anastomosis resulting in failure of the surgery is the most common late postoperative complication.

Failure of DCR by block of anastomosis can be prevented by

Inserting Implants in the ostium to keep it patent.

CHALAZION

1. *Biodata:*
   Here is a male/female patient aged about .... years, ... by occupation, hailing from ....
2. *Presenting Complaints:*
   His presenting Complaints are Swelling in eyelid since .... months/years

Chalazion is the most common nodular swelling of the eyelids.

3. *History of Presenting Illness:*
   He/She was apparently normal .... months/years back. He/She noticed painless swelling in upper/lower eyelid of RE/LE/BE insidious in onset, gradually progressive/stationary in nature. Initially it was of the size of about .... mm now it has progressed to the present size.
4. *Associated features:*
   - Pain
   - Redness
   - Watering
   - Discharge
   - Diminision of vision.

Pain, redness, watering are features of inflammation seen in internal hordeolum and external hordeolum which have to be differentiated from chalazion which is painless in nature.

Secondary infection of a chalazion leads to formation of internal hordeolum which presents with pain, redness.

Discharge is seen when external/internal hordeolm ruptures or when associated with lid abscess.

Diminision of vision is rarely seen in chalazion when seen it is either because of mechanical ptosis or due to astigmatism because of upper lid chalazion pressing on the cornea.

5. *Ocular history:*
   He/She is/was wearing spectacles for
   - Near vision
   - Distance vision (choose one among three)
   - Both.

   He/She gives history of similar complaints/no history of similar complaints.

Chalazion is more common in people with refractive errors, diabetes.

Chalazion can reccur after incision and curettage if the contents are not completely removed.

6. *Past history:*
   He/She is a known diabetic on treatment/not a known diabetic.
   He/She is a known hypertensive on treatment/not a known hypertensive.

Chalazion is more common in diabetics, immunocompromised individuals.

7. *Family history:* Not significant
8. Personal history and socioeconomic history

Chalazion is more common in people with poor facial hygiene with habits of rubbing of eyes with dirty fingers.

OCULAR EXAMINATION

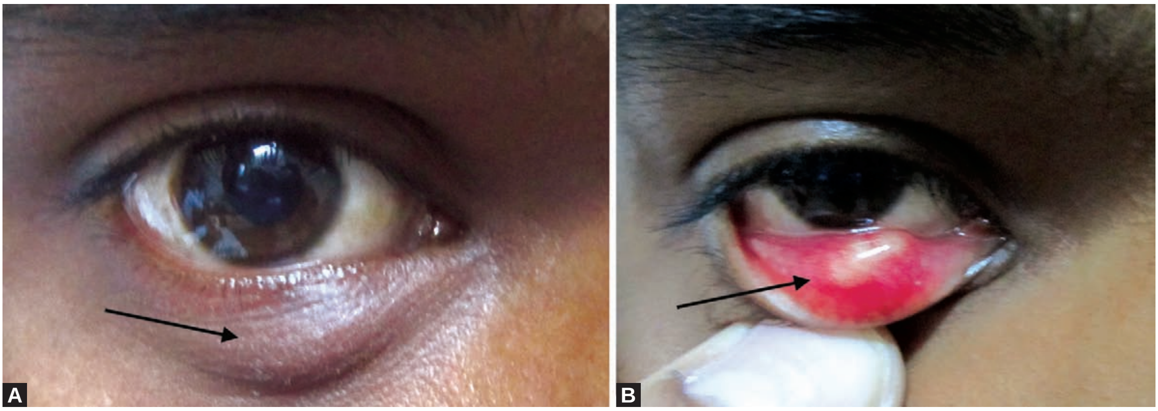
Chalazion presents as painless slowly growing firm nodular mass in the tarsal plate away from the lid margin pointing towards the conjunctival side (rarely it can point towards skin side).

Internal hordeolum presents as acute, painful swelling away from the lid margin pointing towards the conjunctival side.

External hordeolum presents as acute, painful swelling at the lid margin pointing towards the skin side. **(Figs 4.14A and B)**.

Chalazion has to be described under the headings:

- Site
- Size
- Shape
- Skin over the swelling
- Pointing towards conjunctival side/skin side.



Figs 4.14A and B: Chalazion. *Note:* Swelling away from the lid margin with absence of inflammatory signs. It is pointing towards the conjunctival side

Differential Diagnosis

- *Xanthelasma*: Yellow plaques on the skin of the eyelids due to deposition of lipids which may be associated with high cholesterol level.
- *Molluscum contagiousm*: Small pale white umblicated elevated nodule seen on the lids caused by viral infection and treated by cauterization.
- *Papilloma*: Benign tumor of the eyelid presents as pedunculated lesion sebaceous gland carcinoma-rare tumor arising from the meibomian gland. Usually seen in elderly people. It is highly malignant tumor having fast growth and spread to the lymph nodes
- *Internal hordeolum*: Suppurative inflammation of meibomian gland and associated with inflammatory symptoms.
- *External hordeolum*: Suppurative inflammation of gland of Zeiss or Moll, presents towards skin side and associated with inflammatory symptoms.

Define Chalazion

It is a subacute or chronic nonsuppurative inflammation of meibomian gland.

Synonyms

- Tarsal cyst
- Meibomian cyst.

What is the Etiology of Chalazion?

- Chronic blepharitis
- Uncorrected refractive errors leading to eye strain
- Bad habits like rubbing of eyes with dirty fingers
- Diabetes mellitus.

What is the Pathogenesis of Chalazion?

Histopathologically chalazion is lipogranulomatous inflammation with histological picture showing inflammatory cells surrounding the areas of lipid indicated by clear spaces.

Mild inflammation of the meibomian gland by a low virulence organism → Blockage of the duct of the meibomian gland → Accumulation of lipid secretion → Break down of lipid into component of oleic acid → Mucosal irritation → Cellular infiltration with formation of giant cell → Proliferation of fibroblast → Granuloma formation.

What are the Complications of Chalazion?

- The chalazion may get enlarged causing mechanical ptosis, blurred vision because of astigmatism induced by pressing of upper lid on cornea in cases of upper lid chalazion and watering because of eversion of lower lid in case of lower lid chalazion.
- Secondary infection of chalazion leading to internal hordeolum.
- Burst chalazion-fungating mass of granulation tissue seen on the conjunctival side due to rupture of chalazion.
- Malignant change into meibomian gland carcinoma rarely seen in elderly people.
- Calcification.

What is Marginal Chalazion?

Chalazion seen at the lid margin because of extension via the meibomian ducts is called marginal chalazion.

What is the Treatment of Chalazion?

- Conservative treatment in the form of hot fomentation,topical antibiotic eyedrops for small chalazion.
- Intralesional injection of long acting steroids like triamcinolone.
- Incision and curettage.
- Diathermy.

Work-up of patient with chalazion

- Look for refractive error, correct it if present
- Urine sugar/RBS to screen for diabetes
- Bleeding time and cloting time since incision and curettage for chalazion involves incision on the conjunctiva.

Incision and curettage

Anesthesia: Topical 4 percent xylocaine eye drops are instilled to the conjunctival sac, skin above the swelling is infiltrated with 2 percent xylocaine and chalazion clamp is applied.

Vertical incision is made on the conjunctival side to avoid injury to the neighboring meibomian ducts (incision has to be made on the conjunctival side as chalazion usually presents towards conjunctival side and conjunctival incision prevents scar which may be seen in skin incision).

The contents of the chalazion (cheesy material) is curetted out with a chalazion scoop.

Antibiotic eye ointment is applied and a pressure bandage is applied for about 3 hours for hemostasis.

What is the Treatment of Internal Hordeolum?

Treatment is mainly conservative including hot fomentation, topical antibiotics,oral antibiotics and anti-inflammatory drugs.

Recurrent chalazion/multiple chalazion

- Diabetes Mellitus and Immunocompromised state have to be ruled out.
- Chalazion in elderly people, meibomian gland carcinoma has to be ruled out.

Meibomian gland carcinoma

It is a sebaceous gland carcinoma commonly seen in elderly people (incidence in females > males).

Prior history of exposure to radiation is sometimes seen.

It presents as a nodular swelling firm to hard in consistency.

It is a highly malignant tumor having an early spread to lymph nodes.

Treatment is by surgical excision.

PTERYGIUM

1. *Biodata:*
   Here is a male/female patient aged about .... years, ... by occupation, hailing from ....

> Pterygium is a common degenerative condition of conjunctiva seen in middle aged and elderly people It is most common in people living in hot climates.

2. *Presenting Complaints:*
   His presenting complaints are
   Growth in RE/LE/BE since.............months/ years.

> Most of the times patient may not come to hospital because of pterygium as it is asymptomatic except for cosmetic intolerance, unless it causes one of the symptoms.
> - Inflamed pterygium causing pain, redness and watering
> - Diminision of vision due to
>   - Astigmatism because of encroachment to cornea
>   - Encroachment of pupillary area.

3. *History of Presenting Illness:*
   He/She was apparently normal .... months/years back. He/She noticed growth in RE/LE/BE insidious in onset gradually progressive/stationary in nature on nasal side/temporal side.

> History has to be asked to-rule out complications of pterygium like inflammation of pterygium and visual disturbances-assess the growth of pterygium to know whether it is progressive or atrophic.

4. *Ocular history:*
   He/She is/was wearing spectacles for
   - Near vision
   - Distance vision (choose one among three) both.

   He/She gives history of surgery/no history of surgery to RE/LE/BE for similar complaints.

> Recurrence of pterygium is the most common complication after pterygium excision.
> Recurrence rate is 30–50 percent.

5. *Past history:*
   He/She is a known diabetic on treatment / not a known diabetic.
   He/She is a known hypertensive on treatment/not a known hypertensive.
6. *Family history:* Not significant
7. Personal history and socioeconomic history.

OCULAR EXAMINATION

Pterygium has to be addressed as growth during examination and should be examined under

- Site
- Size
- Shape
- Extent
- Vascularization
- Fibrous/fleshy
- Encroachment of cornea
  - Crossing limbus
  - Midway between limbus and pupillary margin
  - Up to pupillary margin
  - Crossing pupillary margin

Differential Diagnosis

- Pseudopterygium
- Pinguecula
- Episcleritis
- Scleritis
- Papilloma
- Ocular surface squamous neoplasia
- Phlyctenular conjunctivitis and keratitis.

Pinguecula may act as precursor for pterygium. Pinguecula has got orientation reverse to that of pterygium, i.e. apex away from limbus and it is yellowish in color.

Episcleritis and Scleritis are seen away from limbus associated with inflammatory symptoms and have to be investigated for underlying autoimmune disorders.

Papilloma has lobulated appearance, does not have apex, neck and body and it is not triangular in shape.

Ocular surface squamous neoplasia appears similar to papilloma but has features like rapid growth and presence of sentinel vessel. Phlyctenular keratoconjunctivitis is inflammation of conjunctiva and or cornea to endogenous allergens which present as a nodular inflammation resembling episcleritis and scleritis.

Pterygium

Pterygium is a greek word meaning wing of a butterfly.

It is a degenerative condition of the conjunctiva characterized by proliferation of subconjunctival tissue as a triangular fleshy mass encroaching the cornea involving the Bowman's membrane and the superficial stroma.

What is the Etiology of Pterygium?

- Exactly etiology is not known
- Increased incidence with increase in exposure to ultraviolet radiation
- Exposure to hot and dusty weather
- Pinguecula may be a precursor for pterygium.

What is the Pathology of Pterygium?

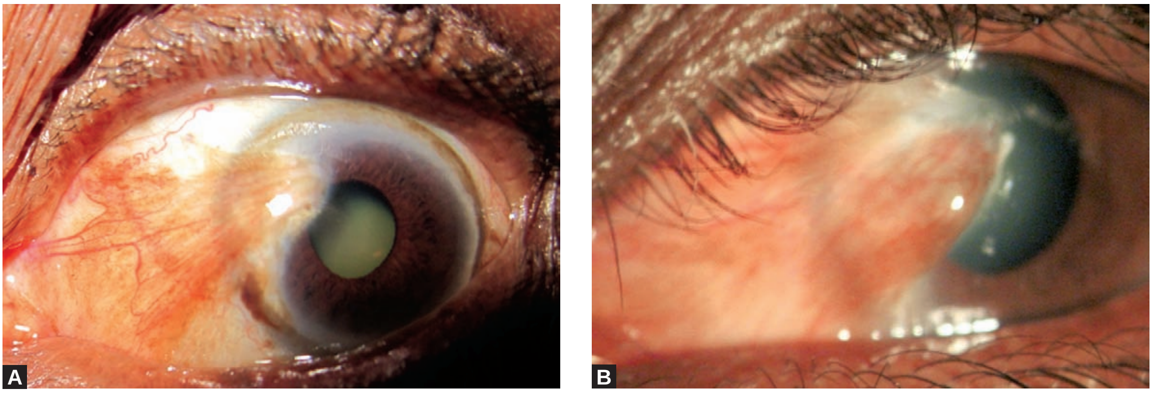
Pathology of pterygium is characterized by elastotic degeneration of the collagen fibers of the substantia propria of conjunctiva with fibrovascular proliferation of granulation tissue under the epithelium.

What are the Parts of Pterygium?

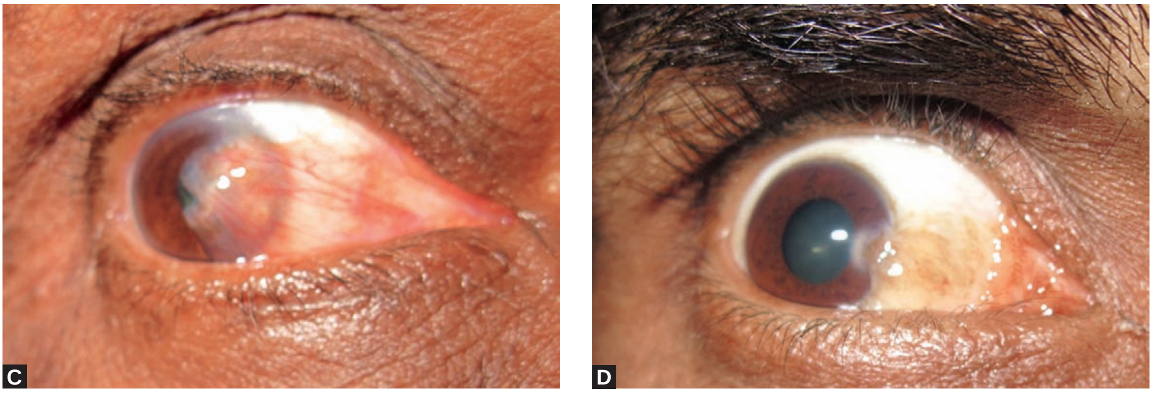
- Apex or head-apical part present on the cornea
- Neck-limbal part
- Body-scleral part
- Cap-infiltrates infront of the apex.

What is Pseudopterygium?

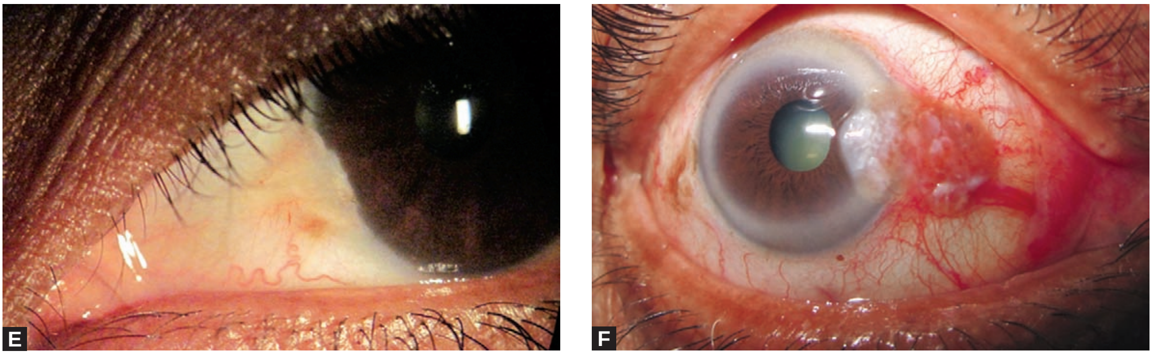
Adhesion of a fold of conjunctiva to peripheral corneal area following chemical burns or inflammation.



Figs 4.15A and B: (A) Progressive pterygium encroaching upto pupillary margin; (B) Progressive pterygium encroaching up to mid pupillary area



Figs 4.15C and D: (C) Progressive pterygium crossing pupillary area; (D) Pterygium with cystic degeneration



Figs 4.15E and F: (E) Pinguecula; (F) Papilloma. *Note:* Yellowish white triangular patch near limbus with apex away from cornea. *Note:* Lobulated mass with dilated vessels surrounding the mass

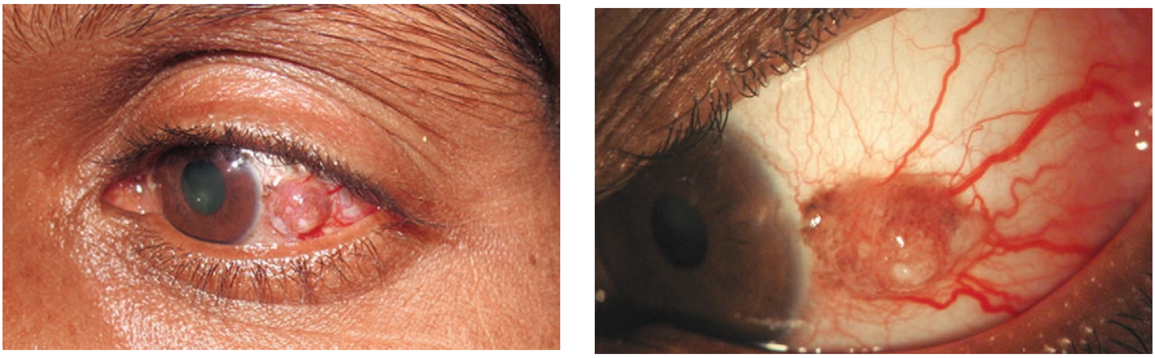
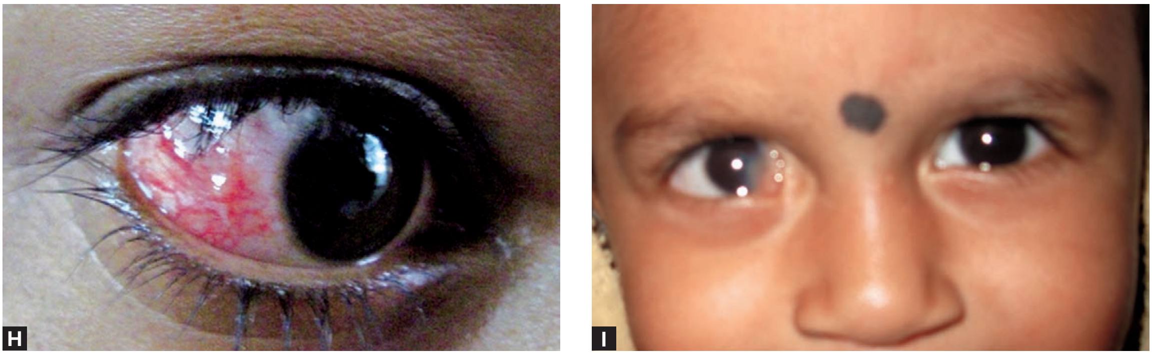


Fig. 4.15G: Ocular surface squamous neoplasia



Figs 4.15H and I: (H) Episcleritis. *Note:* Nodular lesion away from limbus and the congestion is deep to conjunctiva; (I) Limbal dermoid of right eye

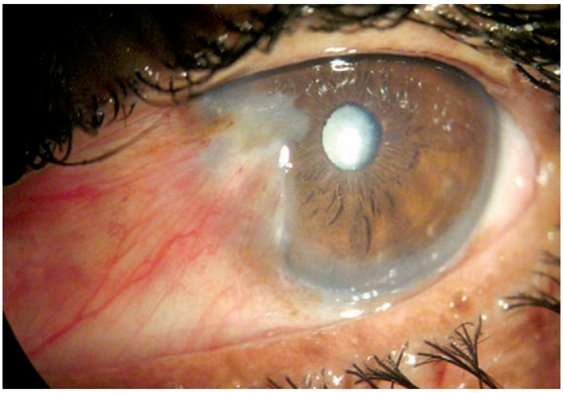


Fig. 4.15J: Cataract with nasal pterygium

How do you Differentiate Pterygium and Pseudopterygium

Pterygium	*Pseudopterygium*
Degenerative condition	Inflammatory condition
Etiology: Exactly not known ultraviolet radiation Exposure to dry and dusty weather	Chemical burns, peripheral corneal ulcer, trauma
Clinical Features: *Age: Usually seen in middle aged and elderly people*	Seen at any age
Site: Nasal or temporal side of the conjunctiva	At any site
Progressive or stationary	Always stationary
Probe test: Probe cannot be passed below the pterygium	As it is fixed only at the apex a probe can be passed easily beneath the neck of the pterygium

What is Stocker Busaca's Line?

Deposition of iron as a line seen in corneal epithelium infront of the apex of the pterygium

Name other Conditions of Deposition of Iron in Cornea

- Fleischer's ring-seen at the base of the keratoconus
- Hudson Stahli's line-a horizontal line seen in the lower half of the cornea at the junction of meeting of upper and lower eyelids due to deposition of hemosiderin pigment.
- Ferry's line-seen infront of filtering bleb
- Coat's ring-rust ring left after removing corneal foreign body.

What are the Stages or Types of Pterygium?

Progressive pterygium: Thick fleshy vascular with infiltrates(cap) infront of the head of the pterygium. It gradually increases in size encroaching towards the center of the cornea.

Atrophic pterygium: Thin atrophic with little vascularity, no cap and it is stationary.

What are the Indications for Excision of Pterygium?

Optical: Diminision of vision due to corneal astigmatism or obstruction of the visual axis.

Cosmetic

Therapeutic: In recurrent inflammation of pterygium

Rarely to treat diplopia due to limitation of ocular movements.

What are the Complications of Pterygium?

- Recurrent inflammations causing inflamed pterygium
- Cystic degeneration
- Rarely neoplastic change to epithelioma and fibrosarcoma (this complication is very very rare).

What is the Treatment of Pterygium?

- Surgical excision is the treatment of choice for pterygium.
  - The various methods of pterygium excision are
- Mcreynolds operation-transplantation of the head of the pterygium under bulbar conjunctiva in lower fomix.
- Simple pterygium excision
  - Simple pterygium excision with primary closure of the conjunctiva
  - Pterygium excision with Bare sclera technique
- Pterygium excision with grafting
  - Pterygium excision with free conjunctival graft
  - Pterygium excision with amniotic membrane graft
  - Pterygium excision with mucous membrane graft
  - Pterygium excision with limbal conjunctival graft
  - Pterygium excision with rotational conjunctival graft

- Pterygium excision with adjunct antimetabolites
  - Thiotepa eyedrops 4 times daily for 6 weeks, concentration used 1 in 2000
  - Mitomycin-C 0.02 percent applied locally during surgery.

Mitomycin-C is used in trabeculectomy for local application over sclera to prevent bleb failure other than its use in pterygium excision.

- Pterygium excision with Beta irradiation not more than 2000 rads during the first week of surgery
- Pterygium PERFECT-Pterygium Extensive Resection Followed by Extended Conjunctival graft
- Pterygium involving the pupillary area-resection of the pterygium with key hole lamellar keratoplasty.

Pterygium cannot be removed without leaving scar on the cornea as it involves bowman's membrane.

Any lesion which involves bowman's membrane will leave scar. The scar left behind depending on the density requires phototherapeutic keratectomy or lamellar keratoplasty.

Recurrence of pterygium is the most common complication after pterygium excision.

Recurrence rate is 30–50 percent.

Bare sclera excision has got maximum recurrence rate.

Pterygium excision by other methods has got relatively less recurrence rates.

Pterygium excision with limbal conjunctival graft has got least recurrence rate.

What are the Causes for Recurrence of Pterygium?

Recurrence of pterygium is because of proliferation of granulation tissue as the conjunctiva is incised during excision of pterygium.

Recent hypothesis for recurrence of pterygium is-pterygium is regarded as due to problem in the stem cells present in the limbal area and because of proliferation of these stem cells pterygium reccurs. (That is why pterygium excision with limbal conjunctival grafting which replaces these damaged stem cells has got least amount of recurrence).

Measures to prevent recurrence of pterygium

Application of antimetabolites

Thiotepa eyedrops 4 times daily for 6 weeks concentration used 1 in 2000.

Mitomycin-C 0.02 percent applied locally during surgery.

Beta radiation from strontium 90 in the dosage of 2500 rads.

Mitomycin-C

It is a antibiotic antimetabolite.

Mechanism of action: Affects DNA synthesis by preventing cross linking between adenine and guanine

Dosage: 0.02 percent.

Uses: For local application during pterygium surgery to prevent recurrence.

For local application during trabeculectomy to prevent failure

Complications

- Mitomycin-C is toxic to corneal endothelium, inadvertent entry into anterior chamber leads to corneal decompensation.
- Scleral necrosis
- Conjunctival wound leak causing overfiltration leading to hypotonous maculopathy following its use in trabeculectomy.

Why pterygium is more common on nasal side

Pterygium is more common on nasal side compared to temporal side because of

- More exposure of nasal conjunctiva to sun light compared to temporal conjunctiva because of reflection of light rays from nasal bones
- Because of collection of tears in medial canthus, waste products which are carried along with tears stay in the nasal side for more time there by irritating the nasal conjunctiva more than temporal conjunctiva.

Anesthesia for pterygium surgery

Pterygium excision is usually done under topical anesthesia with 4 percent lignocaine and infiltration of anesthesia (2 percent lignocaine) into the pterygium.

It can also be done under subtenon's anesthesia or peribulbar anesthesia particularly when conjunctival graft is planned.

Procedure of pterygium excision

After anesthesia eye is painted and draped.

Pterygium head is detached/dissected from the cornea. Body of the pterygium is separated from the surrounding conjunctiva, tenon's tissue and it is cut taking precaution not to injure horizontal rectus muscle.

The next step depends on the type of surgery planned like in pterygium excision with antimetabolites, antimetabolites are applied to the bare sclera, conjunctival graft taken from the superotemporal conjunctiva is sutured to cut ends of the conjunctiva in pterygium excision with free conjunctival graft, limbal conjunctiva is sutured to cut ends of conjunctiva in pterygium excision with limbal conjunctival graft .....

Complications of pterygium surgery

Intraoperative:

- Bleeding from conjunctival vessels
- Injury to surrounding structures like corneal perforation, scleral perforation, injury to horizontal recti.

Postoperative:

- Corneal opacity is usually seen following pterygium excision as it usually invades deeper than Bowman's membrane
- Recurrence of pterygium is the most common complication
- Diplopia due to restriction of ocular movements because of formation of adhesions
- Suture granuloma and cyst formation
- Scleral thining and necrosis particularly when antimetabolites are used.

Postoperative regimen after pterygium excision

- Milder topical steroids like fluorometholone or dexamethasone with topical antibiotics to prevent secondary bacterial infection used 4–6 times for about 4 weeks. (steroids have to be used carefully because of the presence of corneal epithelial defect which is made by detaching/dissecting the head of the pterygium from cornea)
- Artificial tears used 4–6 times for about 2 weeks.

CORNEAL ULCER

1. *Biodata:*

   Here is a male/female patient aged about .... years, ... by occupation, hailing from.

Important facts

Corneal ulcer is more common in:

- Males
- Agricultural workers
- Rural population

2. *Presenting Complaints:*

   His/Her presenting complaints are Pain, redness and watering in RE/LE since............ days.

3. *History of Presenting Illness:*

   He/She was apparently normal............days back. He/She noticed pain, redness and watering in RE/LE

   Pain has to be evaluated further under the headings:

   - Onset
   - Nature
   - Aggravating factors and relieving factors if any.

   Associated features:

   - Photophobia
   - Blurring of vision/diminision of vision
   - Whitish/grayish white/yellowish white lesion noticed in the eye on the cornea.

Corneal ulcer (ulcerative keratitis) is a inflammatory condition hence all the features of inflammation are seen:

- Rubor—redness
- Dolar-pain
- Tumor-swelling/edema of the eyelids
- Functiolasa-diminision of vision/blurring of vision
- Pain is due to effects of bacterial toxins on the nerve endings, irritating the nerve endings causing pain.
- Photophobia is due to stimulation of nerve endings.
- Diminision of vision is due to corneal edema/ corneal haziness because of inflammation.

Most of the cases of corneal ulcer follow trauma /fall of foreign body.

Bacterial corneal ulcers usually follow as secondary infection of epithelial defects of cornea which can be seen as a result of ocular trauma, ocular burns,corneal edema, corneal surgery.

Fungal corneal (filamentous keratomycosis) ulcer usually follows trauma with vegetative matter.

Fungal corneal ulcer due to *Candida* is commonly encountered in patients with low ocular immunity or low systemic immunity.

Immunologically compromised patients are at high-risk of herpetic infections, i.e. viral keratitis.

Contact lenses are leading predisposing factor for Acanthamoeba keratitis.

H/O trauma/no H/O trauma (if H/O trauma is present).

Nature and mode of trauma.

When history of trauma is present, its nature has to be enquired.

Risk factors for development of corneal ulcer have to be evaluated in history.

Ocular factors: Ocular trauma, ocular burns, corneal surgery, contact lens usage, dry eye.

Systemic factors: Old age, infancy, immunosuppressive therapy, immunocompromised state, drug addiction, malignancies, malnutrition.

4. *Ocular history:*

   He/She is/was wearing spectacles for

   - Near vision
   - Distance vision (choose one among three)
   - Both.

   He/She gives history of surgery/no history of surgery to RE/LE.

   He/She gives history of using eyedrops.

Corneal ulcers follow use of steroid eyedrops because of decrease in immunity.

Use of antibiotics may disturb symbiosis between the bacteria and fungi making the facultative organisms pathogenic.

Viral corneal ulcers usually have history of recurrence.

5. *Past history:*
   He/She is a known diabetic on treatment/not a known diabetic.
   He/She is a known hypertensive on treatment/not a known hypertensive.

Fungal corneal ulcers are common in:
- Diabetics
- Immunocompromised states
- Immunosuppressive therapy

6. *Family history:* Significant/not significant
7. *Personal history:*
   - Diet
   - Appetite
   - Habits
8. Socioeconomic history:
   He/She belongs to
   - Upper class
   - Middle class
   - Lower class.

Corneal ulcer is more common in low socioeconomic status because of more incidence of trauma, malnutrition.

OCULAR EXAMINATION

Corneal ulcer has to be examined under the following headings:
- Site of corneal ulcer in relation to the limbus and pupil
- Shape
- Size
- Depth
- Color and appearance
- Association with hypopyon.

Bacterial Corneal Ulcer Showing Various Stages (Fig. 4.16A)

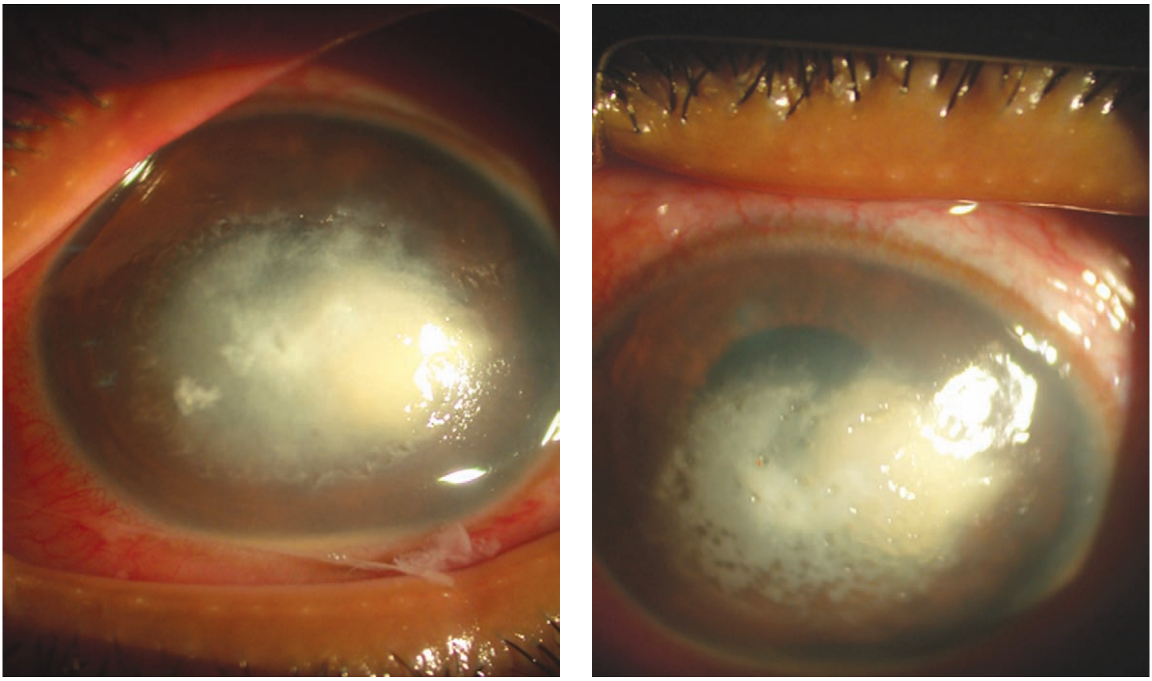


Fig. 4.16A: Stage of progressive infiltration and active ulceration

CASE DISCUSSION

Corneal Ulcer

Corneal ulcer is defined as a break in the corneal epithelium with underlying necrosis of cornea.

Etiological Factors of Corneal Ulcer

Infective Causes

- Bacteria including gram-positive cocci like Staphylococci, Streptococci, Gram positive bacilli like *Corynebacterium, Listeria, Actinomyces* Gram negative bacilli like *Pseudomonas, Proteus, Haemophilus*, Gram negative cocci like *Neisseria Gonorrhoeae*.
- Fungi including Filamentous Fungi like *Fusarium, Aspergillus, Cephalosporium, Penicillium*. Yeasts and fungi like *Candida, Cryptococcus*.
- Viruses including Herpes simplex,*Varicella-zoster*.
- Protozoa including *Acanthamoeba*..

Non Infective Causes

- Trauma including chemical injury, mechanical injury.
- Neurological like Neurotrophic keratitis (fifth nerve lesion), Neuroparalytic keratitis (seventh nerve lesion)
- Immunological diseases like collagen vascular disorders, mooren's ulcer.
- Dermatological lesions like Rosacea, Pemphigoid.
- Nutritional like keratomalacia.
- Postinfectious like metaherpetic keratitis.

What are the Stages of Corneal Ulcer?

- Stage of progressive infiltration
- Stage of active ulceration
- Stage of regression **(Fig. 4.16B)**
- Stage of cicatrization **(Fig. 4.16C)**.

Name the Bacteria which can Penetrate Intact Corneal Epithelium

- *Neisseria gonorrhoeae*
- *Corynebacterium diphtheriae*
- *Listeria monocytogenes*
- *Haemophilus influenzae*.

> Fungi cannot penetrate intact corneal epithelium but they can penetrate intact Descemet's membrane and endothelium, hence hypopyon in case of fungal corneal ulcer is not sterile, i.e. fungi can be seen in anterior chamber.

What are the Predisposing Factors for Bacterial Corneal Ulcer?

Other than four bacteria mentioned above, other bacteria cannot penetrate intact corneal epithelium and hence they require corneal epithelial defect as predisposing factor which may be seen following:

- Trauma to corneal epithelium
- Corneal diseases like bullous keratopathy, neurotrophic keratopathy, exposure keratopathy, dry eye syndrome.

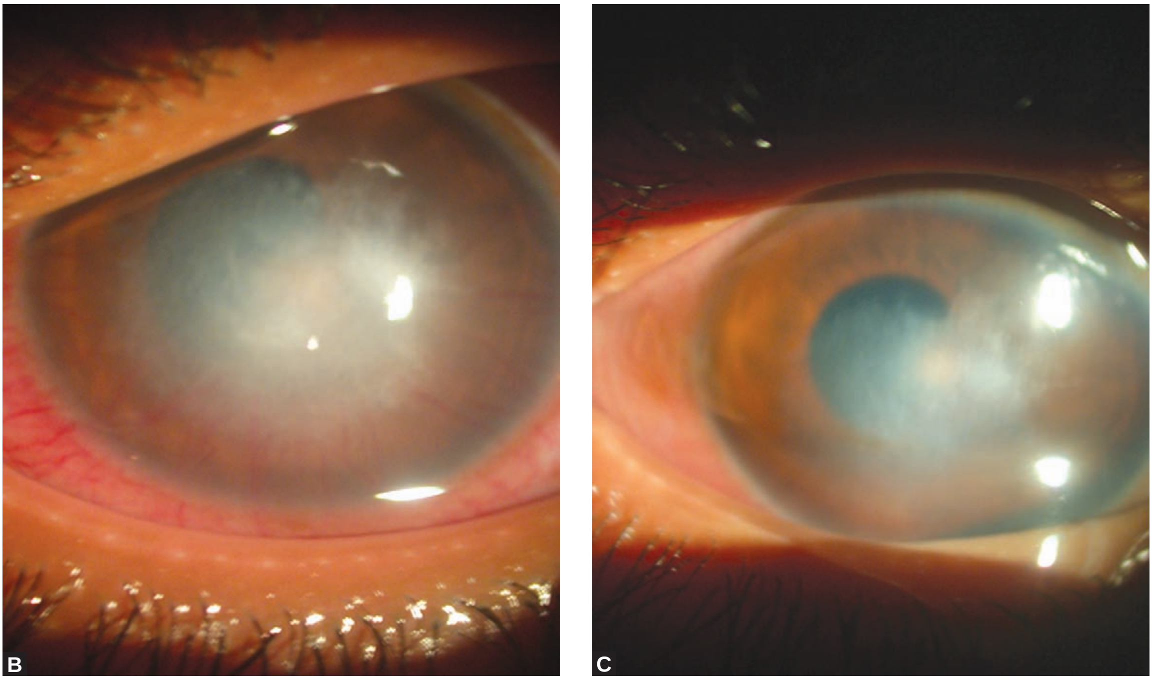
What is Hypopyon Corneal Ulcer or Ulcus Serpens?

The ulcer caused by *Pneumococcus* which creeps over cornea in a serpiginous fashion and associated with a hypopyon is called hypopyon corneal ulcer or ulcus serpens.

It is seen commonly in old debilitated patients and alcoholics.

The source of infection is usually chronic dacryocystitis.

> ***Hypopyon corneal ulcer***
>
> The ulcer creeps over cornea in a serpiginous fashion and hence called ulcus serpens.
>
> The ulcer is usually greater at the edges and the ulcer spreads on one side and at the other side cicatrization may be seen.
>
> Severe iridocyclitis with hypopyon is usually seen.



Figs 4.16B and C: (B) Stage of regression; (C) Stage of cicatrization

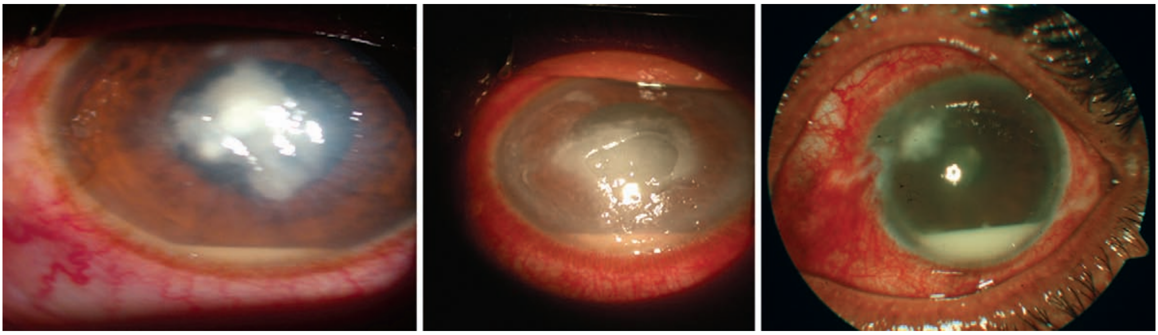


Fig. 4.16D: Fungal corneal ulcer. *Note: Corneal ulcer with features suggesting fungal etiology like dry, elevated, grayish white, feathery extensions, hypopyon…*

Corneal ulcer with hypopyon

Corneal ulcer associated with hypopyon due to other organisms like pseudomonas, gonococci, staphylococci, streptococci, fungi, are included in this list. These ulcers would not show the characteristic features of hypopyon corneal ulcer caused by pneumococci as described above.

Hypopyon

Collection of pus in anterior chamber is called as hypopyon.

Hypopyon is because of associated iritis (caused by toxins causing corneal ulcer) causing outpouring of leukocytes from the vessels which gravitate and collect at the bottom of the anterior chamber as hypopyon.

Bacteria cannot penetrate corneal endothelium hence hypopyon in case of bacterial corneal ulcer is sterile. Fungi can penetrate intact corneal endothelium hence hypopyon in case of fungal corneal ulcer is not sterile.

What are the Sources of Infection for Corneal Ulcer?

- Exogenous causes like water or air borne infections..
- Endogenous infections like septicemia, systemic infective conditions usually seen in immunocompromised individuals
- From the surrounding structures like conjunctival sac, lacrimal sac.

What are the Complications of Corneal Ulcer?

- Descemetocele
- Toxic iridocyclitis
- Secondary inflammatory glaucoma
- Perforation of corneal ulcer.

What are the Complications of Perforated Corneal Ulcer?

- Anterior synechiae
- Iris prolapse
- Adherent leucoma
- Anterior staphyloma
- Phthisis bulbi
- Anterior capsular cataract
- Subluxation or dislocation of the lens
- Expulsive hemorrhage
- Panophthalmitis.

Workup of a patient with corneal ulcer

Detailed history regarding mode of onset of the ulcer.

General physical examination to know any systemic predisposing factors like diabetes, immunodeficiency, malnutrition.

Ocular examination to rule out infection of the surrounding structures like conjunctivitis, chronic dacryocystitis (lacrimal syringing is mandatory in all cases of corneal ulcer).

Slit lamp examination of corneal ulcer after staining with 2 percent fluorescein to look for the morphology of the ulcer.

Laboratory investigations

- Blood sugar/urine sugar to rule out diabetes
- Corneal scraping and Gram's staining, Giemsa staining, KOH mount, culture on Blood agar, Sabouraud's dextrose agar.

Morphological characters of corneal ulcers

Bacterial corneal ulcer caused by:

Staphylococcus aureus—yellowish white dense opaque corneal ulcer surrounded by a relatively clear cornea.

Pseudomonas-irregular deep corneal ulcer with ground glass appearance associated with mucopurulent greenish exudates.

Enterobacteriae-shallow ulcer with pleomorphic grayish white necrotic area.

Pneumococcus-serpiginous ulcer.

Fungal corneal ulcer

D —dry looking
E —elevated margins
F —feathery finger like extensions
G —grayish white in color
H —big hypopyon
I —immune ring and independent satellite lesions

Viral corneal ulcer

Herpes simplex—dendritic ulcer with markedly reduced corneal sensation.

Herpes Zoster—pseudodendritic ulcer with characteristic vesicular skin lesions not crossing the midline.

What is the Treatment Protocol for Corneal Ulcer?

Nonspecific treatment

- Cycloplegic drugs preferably atropine 1 percent eye ointment
- Systemic analgesics and anti-inflammatory drugs like Tab. Diclofenac 50 mg twice a day.

Specific treatment

- It depends on the cause of corneal ulcer, i.e. Bacteria, fungi, virus.

Bacterial corneal ulcer

- Initial therapy before the result of culture and sensitivity - broad spectrum antibiotics like Fortified Gentamycin (14 mg/ml) or Fortified Tobramycin and Fortified Cephazoline (50 mg/ml) hourly to begin with and gradually tapered
- Later the antibiotics are changed according to the culture and sensitivity report
- Systemic antibiotics are indicated in cases of
  - Large corneal ulcers extending up to limbus
  - Corneal ulcers associated with hypopyon.

Fungal corneal ulcer ***(Fig. 4.16D)***

For Fusarium keratitis

- Natamycin 5 percent eyedrops initially hourly and then gradually tapered
- Oral Fluconazole 100 mg twice a day in case of deep keratitis
- Broad spectrum topical antibiotic eyedrops like 0.3 percent ciprofloxacin to prevent secondary bacterial infection.

For Aspergillus and Candida Keratitis:

- Amphotericin B 0.15 percent eyedrops
- Oral Fluconazole 100 mg twice a day in case of deep keratitis
- Broad spectrum topical antibiotic eyedrops to prevent secondary bacterial infection.

Viral corneal ulcer

For herpes simplex keratitis

- Acyclovir 3 percent eye ointment 5 times per day
- Broad spectrum topical antibiotic eyedrops to prevent secondary bacterial infection.

For herpes zoster keratitis

- Systemic Acyclovir 800 mg 5 times per day
- Topical Acyclovir 3 percent eye ointment 5 times per day
- Oral steroids in case of neurological complications like third nerve palsy. docyclitis, scleritis.

Acantamoeba keratitis

- One percent Propamidine eyedrops
- Neomycin eyedrops
- Polyhexamethylene biguanide eyedrops
- Oral Fluconazole 100 mg twice a day in case of deep keratitis
- Broad spectrum topical antibiotic eyedrops to prevent secondary bacterial infection.

What is the Role of Atropine in the Treatment of Corneal Ulcer?

- It reduces pain and ciliary spasm
- Prevents formation of posterior synechiae from secondary iridocyclitis
- Increases the blood supply to anterior uvea so brings more antibodies in the aqueous humor
- Decreases hyperemia and vascular permeability.

What are the Causes for Nonhealing Corneal Ulcer?

- Systemic causes like diabetes mellitus, immunocompromised state, malnutrition.
- Ocular causes like dacryocystitis, presence of foreign body, trichiasis.

What is the Treatment of non Healing Corneal Ulcer?

- Identifying and treating any cause for nonhealing corneal ulcer
- Debridement of the ulcer
- Cauterization of the ulcer with carbolic acid
- Conjunctival peritomy.

What is the Treatment of Perforated Corneal Ulcer?

- It depends on the size of the perforation
- Small perforation can be treated by tissue adhesive glues, or by covering with bandage contact lens

- Larger perforation needs tectonic keratoplasty
- Perforation can be prevented by taking precautions in the form of
  - Lowering IOP by antiglaucoma medications
  - Asking the patient to avoid straining like sneezing, coughing violently
  - Therapeutic keratoplasty.

What is Atheromatous Corneal Ulcer?

Corneal ulcer seen over old leucomatous opacity with degenerative changes which progresses rapidly with a little tendency to heal is called as atheromatous corneal ulcer.

What is Dendritic Ulcer?

An ulcer which is irregular with linear branching with knobs at the ends typically seen in Herpes simplex epithelial keratitis is called dendritic ulcer.

Differences Between Bacterial, Fungal and Viral Corneal Ulcers

Features	*Bacterial*	*Fungal*	*Viral*
Etiology	Corneal epithelial defect, ocular infections	Injury by vegetative matter, animal tail… Immunocompromised state	Close contact with infected individuals
Symptoms	Marked	Mild	moderate
Signs	Symptoms = signs	Signs > symptoms	Symptoms = signs
Ulcer	Yellowish white to grayish white with wet look	Grayish white with dry look, feathery extensions, elevated	Dendritic pattern
Hypopyon	Sterile and mobile	Nonsterile and stationary	Rarely seen
KP'S	Not seen	Not seen	Common
Recurrences	Nil	Nil	Common
Steroids	Contraindicated	Contraindicated	Contraindicated in infective epithelial keratitis Indicated in disciform keratitis and zoster ophthalmicus
Immune ring	Uncommon	Common	May be seen
Satellite lesions	Not seen	Seen	Not seen
Skin lesions	Not seen	Not seen	Seen
Diagnosis	Culture and sensitivity	Culture and sensitivity	PCR, ELISA…

Trophic corneal ulcer

Ulcer which occurs due to disturbance in the metabolic activity of corneal epithelial cells.

This group includes:

- Exposure keratitis
- Neuroparalytic keratitis
- Neurotrophic keratitis.

Exposure keratitis

Due to exposure of the cornea in conditions like Proptosis, symblepharon, lagophthalmos which leads to drying of cornea, epithelial defect and its secondary infection leading to the formation of corneal ulcer. Prophylaxis is by using artificial tears, lid taping and tarsorraphy to prevent corneal exposure.

Neuroparalytic keratitis

It is due to paralysis of motor nerve supplying eyelids, i.e. facial nerve and the picture is similar to exposure keratitis.

Neurotrophic keratitis

It is due to paralysis of sensory nerve supplying the cornea, i.e. Trigeminal nerve.

Because of disturbance of corneal reflex metabolic activity of corneal epithelium is disturbed which leads to accumulation of metabolites causing corneal edema following corneal ulceration.

Herpes zoster ophthalmicus

Acute infection of the Gasserian ganglion of the trigeminal nerve caused by zoster virus.

It is characterized by vesicular lesions over the skin involving the particular dermatome, systemic manifestations like fever,malaise...

The ocular features include

Corneal lesions: Pseudodendritic ulcer, keratouveitis, sclerokeratitis, disciform keratitis, neurotrophic keratopathy, interstitial keratitis.

Other ocular features include episcleritis, scleritis, uveitis,optic neuritis, extraocular muscle paresis/paralysis.

What is Pseudodendritic Ulcer?

An ulcer which is broader and plaque like when compared to dendritic ulcer, seen in zoster keratitis is called as pseudodendritic ulcer.

What is Disciform Keratitis?

Disk shaped stromal edema without necrosis seen as a result of delayed hypersensitivity teaction to herpes antigen is called disciform keratitis.

What are the Indications for Topical Steroids in Keratitis?

- Herpes zoster keratitis associated with iridocycitis, scleritis
- Disciform keratitis
- Mooren's corneal ulcer
- Interstitial keratitis

What is Interstitial Keratitis?

Inflammation of the corneal stroma without involvement of corneal epithelium and endothelium is called interstitial keratitis.

Causes:

- Tuberculosis
- Syphilis
- Leprosy
- Sarcoidosis
- Cogan's syndrome.

PTOSIS

1. *Biodata:*
   Here is a male/female patient aged about ....years,..........by occupation, from..........
2. *Presenting Complaints:*
   His/Her presenting complaints are Drooping of upper eyelid of RE/LE/BE since months/years
3. *History of Presenting Illness:*

History will differentiate congenital and acquired ptosis. Congenital ptosis will be present at birth with or without family history.

In cases of acquired ptosis enquiry has to be made to find out the etiology.

H/O of trauma or surgery to rule out aponeurotic ptosis.

H/O swelling over the upper lid to rule out mechanical ptosis.

Ptosis may cause diminision of vision when the ptotic eye lid covers the visual axis (this may cause stimulus deprivation amblyopia in children).

4. *Ocular history:*
5. *Past history:*
6. *Family history:* Family history is significant in cases of congenital ptosis.
7. *Personal history and socioeconomic history:*

OCULAR EXAMINATION

Ptosis has to be examined under the following headings.

- Look for microphthalmos, anophthalmos, pthisis bulbi, enophthalmos.... to exclude pseudoptosis
- Palpebral fissure height in straight/primary gaze.

Palpebral fissure height in primary gaze will be decreased on the ptotic side **(Fig. 4.17)**.

- Palpebral fissure height in down gaze

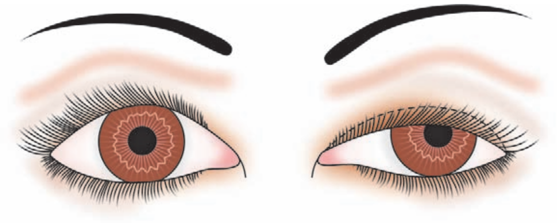


Fig. 4.17: Palpebral fissure height in primary gaze-decreased on ptotic side (left side)

In congenital ptosis palpebral fissure width in down gaze is usually greater on the ptotic side when compared to the normal side!

This is because in congenital ptosis (because of maldeveloped levator palpebrae superioris muscle) the eyelid will not move downwards on looking down.

In acquired ptosis palpebral fissure width in down gaze is less on the ptotic side when compared to the normal side.

- Measurement of degree of ptosis by measuring the amount of cornea covered by the upper eyelid and substracting it by 2 mm (the normal value) **(Fig. 4.18)**.

Depending on this ptosis is classified as

Mild ptosis	2 mm
Moderate ptosis	3 mm
Severe ptosis	4 mm

- Margin reflex distance 1 (MRD 1) distance between the corneal light reflex and the center of the upper eyelid margin in primary gaze. The amount of ptosis in unilateral cases is the difference between the two eyes and in bilateral cases is the difference between the MRD 1 and the normal value (normal value 4.5 mm).
  If the ptotic eyelid is covering the corneal light reflex, MRD 1 is recorded in negative numbers as the number of millimeters the eyelid must be raised to visualize the corneal light reflex.

MRD 1 will be decreased in ptosis **(Fig 4.19)**.

- Margin reflex distance 2 (MRD 2) distance between the corneal light reflex and the center of the lower eyelid margin in primary gaze. MRD 2 is not required for evaluation of ptosis. The only importance being adding MRD 1 and MRD 2 gives palpebral aperture width. Normal MRD 2 value is 5.5 mm.

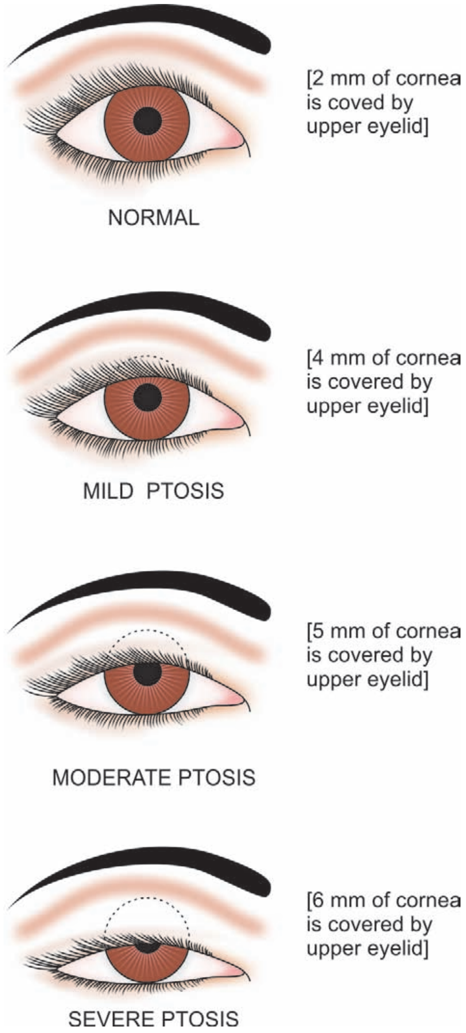

[2 mm of cornea
is coved by
upper eyelid]
NORMAL
[4 mm of cornea
is covered by
upper eyelid]
MILD PTOSIS
[5 mm of cornea
is covered by
upper eyelid]
MODERATE PTOSIS
[6 mm of cornea
is covered by
upper eyelid]
SEVERE PTOSIS

Fig. 4.18: Measurement of degree of ptosis

- Margin reflex distance 3 (MRD 3) distance between the corneal light reflex and the center of the upper eyelid margin in extreme up gaze with frontalis muscle action being prevented by direct pressure applied to the eyebrow **(Fig. 4.20)**.

MRD 3 measures Levator function
Normal MRD 3 is 7 mm

- Margin limbus distance (MLD) distance between the corneal light reflex and the 6 o'clock limbus in extreme up gaze with frontalis muscle action being prevented by direct pressure applied to the eyebrow **(Fig. 4.21)**.

MLD measures Levator function
Normal MLD is 9 mm

- Margin crease distance (MCD) distance between center of the eyelid margin to center of the upper eyelid skin crease in down gaze.

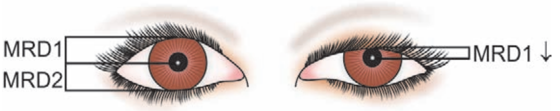

MRD1
MRD2
MRD1 ↓

Fig. 4.19: MRD1. *Note:* MRD1 decreased on ptotic side (Left eye)

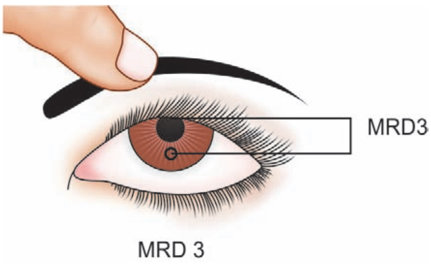


Fig. 4.20: MRD 3

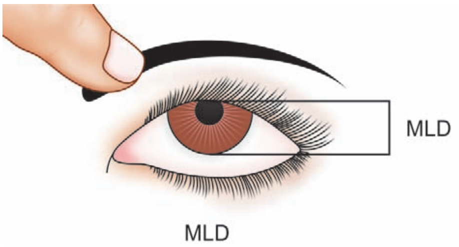


Fig. 4.21: MLD

High eyelid crease indicates disinserted levator aponeurosis(aponeurotic ptosis).

MCD is important to choose the incision site during ptosis surgery as it is important to put the incision on the eyelid crease.

- Levator Muscle Function

  Berke's method: Patient is asked to look in down gaze, action of frontalis muscle is prevented by applying direct pressure to the eye brow. Zero mark of the scale is placed at the center of the upper eyelid margin, patient is asked to look in the extreme upgaze and the amount of lid excursion is measured by reading the number on the scale adjacent to the center of the upper eyelid margin.

Levator function is graded as

Normal	15 mm
Good	8–15 mm
Fair	5–7 mm
Poor	< 4 mm

Levator muscle function can also be measured by MRD 3 and MLD **(Fig. 4.22)**.

xi. Look for
  - Bell's phenomenon
  - Jaw winking phenomenon
  - Strabismus

Bell's phenomenon: It is tested by trying to open the eyelids after the patient is asked to close the eyelids tightly. Normally the eyeball will be rolled upwards.

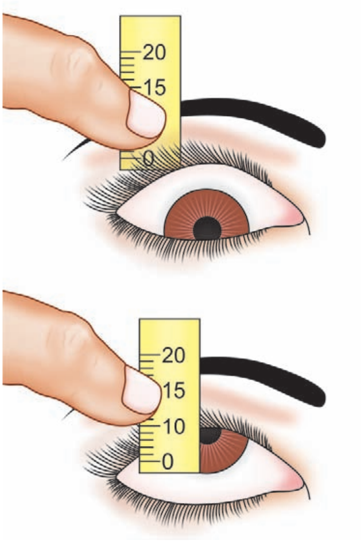


Fig. 4.22: Measuring levator muscle function

Poor Bell's phenomenon is associated with more incidence of exposure keratopathy in the postoperative period because of lagophthalmos which follows ptosis surgery. Hence, absent Bell's phenomenon is a contraindication for ptosis surgery.

Jaw winking phenomenon: It is tested by asking the patient to open and close the mouth and to move the jaw from side-to-side while observing for the movement of the ptotic eyelid.

If Jaw winking phenomenon is present levator resection surgery should not be done as it will increase the jaw winking.

Strabismus: Presence of strabismus particularly hypotropia should be specifically looked for by doing cover and uncover tests.

Hypotropia is one of the causes for pseudoptosis (because of depression of the eye).

Hence, correction of hypotropia has to be made first before operating for ptosis.

CASE DISCUSSION

Blepharoptosis

Ptosis means drooping or sagging of a body part. Blepharoptosis is abnormal drooping of the upper eyelid. Normally, upper eyelid covers about one-sixth of cornea (2 mm). In ptosis it covers more than 2 mm.

Classify Ptosis

- Congenital ptosis
  - Simple congenital ptosis not associated with any ocular or systemic anomaly
  - Complicated.
    a. As a part of blepharophimosis syndrome (blepharophimosis, telecanthus, epicanthus, ptosis).
    b. Congenital synkinetic ptosis (Marcus Gunn jaw winking ptosis).
- Acquired ptosis
  - Myogenic ptosis
  - Neurogenic ptosis
  - Aponeurotic ptosis
  - Mechanical ptosis.

What is the Pathophysiology of Ptosis?

The elevators of the upper eyelid are:

- Levator muscle
- Müller's muscle
- Frontalis muscle.

The weakness of the elevators of the upper lid which may be in the muscle, aponeurosis, neuromuscular junction or in the nerve will result in ptosis.

Myogenic Ptosis

- Levator maldevelopment
- Blepharophimosis syndrome
- Myasthenia gravis
- Progressive muscular dystrophy
- Chronic progressive external ophthalmoplegia
- Oculopharyngial muscular dystrophy

Aponeurotic Ptosis

Trauma to levator aponeurosis (traumatic dehiscence or disinsertion of the aponeurosis) Senile ptosis

Neurogenic Ptosis

- Lesions of third nerve
- Horner's syndrome

Marcus Gunn Jaw Winking Syndrome

Winking or retraction of ptotic eyelid on stimulation of the ipsilateral pterygoid muscle by moving the jaw or by opening of mouth.

It is due to synkinetic innervation of levator and pterygoid muscle.

(Trigeminal nerve which supplies pterygoid muscles falsely/aberrantly supplies levator muscle also, hence with movement of pterygoid muscle levator muscle also contracts causing lid retraction).

Horner's syndrome

It is caused by oculosympathetic palsy.

Clinical features:

- Mild ptosis
- Miosis of pupil
- Enophthalmos
- Elevation of position of lower eyelid (Inverse ptosis)
- Hypochromia of iris in congenital cases.

Causes:

- Central Horner's syndrome
  Lesions between hypothalamus and ciliospinal center of Budge (C8-T2) like demyelination, tumors.
- Preganglionic Horner's syndrome
  Lesions from C8-T2 to Superior cervical ganglion like Pancoast's tumor of lung, carotid artery aneurysm..
- Postganglionic Horner's syndrome
  Lesions in the postganglionic fibers in the head like head injury, cavernous sinus lesions..

Phenyl ephrine test

It is done in case of ptosis when Horner's syndrome is suspected.

One drop of phenylephrine is instilled into the eyes after measuring the amount of ptosis. After

5 minutes the degree of ptosis is reevaluated. Improvement in ptosis indicates that lesion is because of involvement of sympathetic supply, i.e. Horner's syndrome(phenyl ephrine causes contraction of sympathetically innervated Muller's muscle).

Treatment:

Ptosis because of oculosympathetic pariesis is treated by Fasanella Servat operation, i.e. resection of Muller's muscle.

Ocular Myasthenia Gravis

Clinical features

- Variable degree of ptosis with increased ptosis during periods of fatigue
- Eyelid fatigue on sustained upgaze
- Eyelid twitch on upgaze- Cogan's sign.

Ice test:

It is done in case of ptosis when Myasthenia Gravis is suspected.

An ice pack is placed over ptotic eyelid for 10 minutes after measuring the amount of ptosis.

After 10 minutes the degree of ptosis is reevaluated. Improvement in ptosis indicates that lesion is because of Ocular Myasthenia Gravis. Cold temperature enhances neuromuscular transmission by inhibiting acetylcholinesterase and thereby causing improvement in ptosis.

Tensilon test (Edrophonium test)/Neostigmine test:

It is done in case of ptosis when Myasthenia Gravis is suspected.

Tensilon (edrophonium) 10 mg is injected intravenously or Neostigmine 4 mg is injected intramuscularly after measuring the amount of ptosis. Amount of ptosis is reevaluated after 2 minutes when Tensilon is used /after 10 minutes when Neostigmine is used. Improvement in ptosis indicates that lesion is because of Ocular Myasthenia Gravis.

Edrophonium and Neostigmine are anticholinesterases and hence enhance neuromuscular transmission and thereby causing improvement in ptosis.

What is the Treatment for Ptosis?

Congenital ptosis

Surgery is the treatment of choice

- Timing of surgery
- *Mild to moderate ptosis:* Surgery may be delayed till 4 years of age so that accurate measurements can be taken when the child can cooperate for ptosis measurements.
- *Severe ptosis:* Surgery should be performed as early as possible to prevent ambylopia.

The type of surgery is determined by

- Amount of ptosis
- Levator muscle action.

Fasanella servat operation

Indication: Mild ptosis with good levator muscle function.

Levator resection

Indication: Moderate to severe ptosis with good to moderate levator function.

Frontalis sling operation

Indication: Severe ptosis with poor levator muscle function

Acquired ptosis:

Underlying cause has to be identified and treated. Surgery if required is choosen as per the guidelines of congenital ptosis.

CHAPTER 5

DIAGNOSTIC TESTS IN OPHTHALMOLOGY

CHAPTER OUTLINE

- Tonometry
- Slit Lamp Examination
- Ophthalmoscopy
- Keratometry
- Retinoscopy
- Gonioscopy
- Perimetry
- Ultrasonography
- Ultrasound Biomicroscopy
- Vital Stains
- Specular Microscopy
- Fundus Fluorescein Angiography
- Indocyanine Green Angiography
- Optical Coherence Tomography
- Heidelberg Retinal Tomograph
- Corneal Topography
- Electrophysiological Tests
- Retinal Function Tests
- Macular Function Tests
- Tests for Evaluation of a Case of Watering Eye
- Tests for Evaluation of a Case of Squint
- Tests for Evaluation of Tear Film

TONOMETRY

Measurement of intraocular pressure (IOP) with tonometer is called as tonometry.

> Measurement of intraocular pressure is defined as the pressure exerted by the intraocular contents on sclera and cornea.
>
> Normally, IOP varies between 10 and 21 mm Hg +/-2.5 standard deviation.
>
> Persistent IOP above 21 mm Hg or below 7 mm Hg will produce structural and functional changes in the eye.

Digital Tonometry

Measurement of intraocular pressure can be roughly estimated by palpating the eyeball with index fingers of both hands after asking the patient to look down. Index finger of one hand indents the eyeball while the index finger of the other hand feels the pressure changes produced by the indenting finger.

In cases of raised IOP, the eyeball is felt hard.

Indentation Tonometry (Schiotz Tonometer)

Principle: A fluid filled globe when indented by a plunger, the plunger will sink in the globe till the pressure of the plunger is equal to the pressure inside the globe.

It is done by Schiotz Tonometer.

Parts of Schiotz Tonometer

- Foot plate which rests on the cornea
- Plunger which moves freely within a shaft
- Indicator needle
- Scale
- Holder
- Weight **(Fig. 5.1)**.

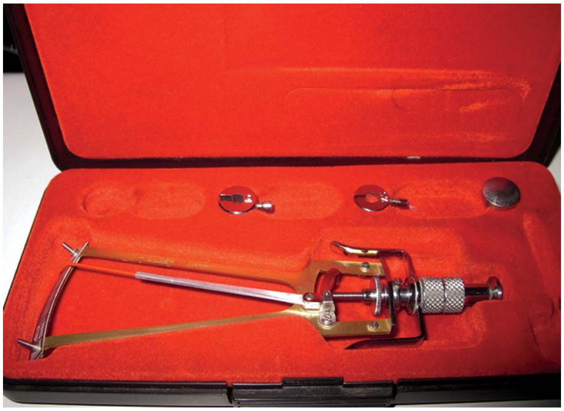


Fig. 5.1: Schiotz tonometer

Technique of Schiotz Indentation Tonometry

Topical anesthesia with 4 percent xylocaine.

Patient is asked to lie down in supine position and fix a target with both eyes kept open widely.

The foot plate of the Schiotz Tonometer is placed gently over the cornea so that the plunger is in front of the pupil and at right angle to the iris surface.

The plunger is allowed to fall freely on the cornea without exerting pressure.

The deflection of the indicator on the scale is noted.

Procedure is started with the fixed 5.5 gm weight.

If the deflection is less than 3 on the scale, 7.5 gm, 10 gm, 15 gm weights one after the other are used and the average of the 3 readings is taken as mean IOP.

A conversion table is then used to derive the IOP in mm Hg from the scale reading.

Disadvantages: Indentation is influenced by scleral rigidity, hence it is not an accurate method.

Applanation Tonometry

Goldmann Applanation Tonometer

Principle: This is based on Imbert Fick law which states that for an ideal, dry, thin walled sphere, the pressure inside the sphere (P) is equal to the force necessary to flatten its surface (F) divided by the area of flattening (A).

$$P = F/A$$

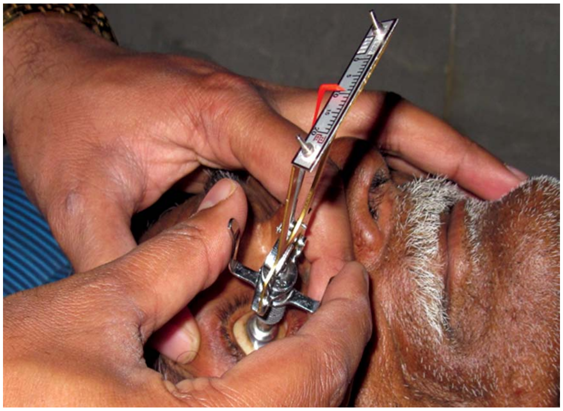


Fig. 5.2: Schiotz tonometry

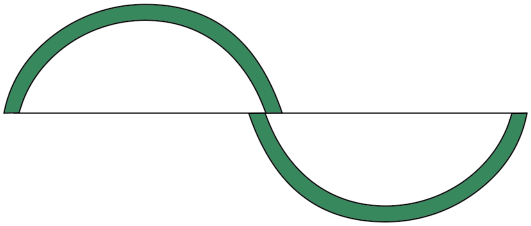


Fig. 5.3: End point of Applanation Tonometry—Inner edges of semicircles touching each other

The IOP is proportional to the pressure applied to the globe, i.e. the cornea and the thickness of the walls of the globe.

Structure: It consists of a double prism mounted on a slit lamp.

Technique:

- Topical anesthesia with 4 percent xylocaine
- Tear film is stained with fluorescein
- Patient is seated infront of the slit lamp
- Biprisms are illuminated from slit lamp with cobalt blue filter
- Biprism is moved forward to touch the cornea in the center
- When the prisms touch the cornea two semicircles are seen through the prism
- The applanation force is adjusted till the inner edges of the semicircles touch.
- The IOP is measured by multiplying the reading on the dial by ten.

Advantages: It is most accurate method considered as gold standard for measurement of IOP because it is not affected by scleral rigidity.

Other applanation tonometers:

- Perkins hand held applanation tonometer
- Air puff tonometer
- Tonopen
- Noncontact tonometers.

SLIT LAMP EXAMINATION

Slit lamp is the most important of all the ophthalmological instruments as the complete ophthalmological examination can be done with this instrument by combining it with other accessories.

Parts: Slit lamp consists of illumination system, engineering support and observation system.

Optics: Slit lamp works on the principle of compound microscope. Slit lamp consists of +22 D objective lens, +10 to +16 D eyepiece. Magnification produced by the equipment is in the range of 10–16 times, (newer slit lamps with zoom magnification provide magnification in the range of 7–35 times).

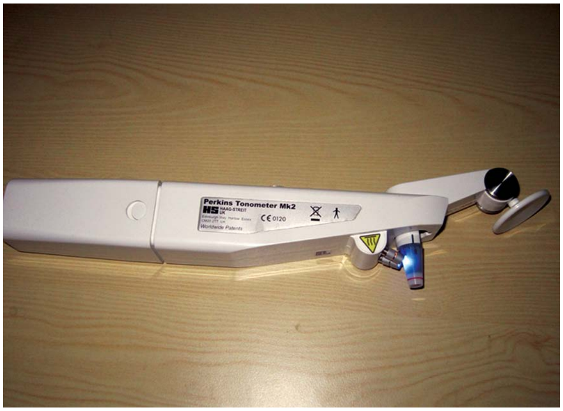


Fig. 5.4: Perkins hand held applanation tonometer

Slit lamp provides both illumination and magnification which is required for ophthalmological examination.

Filters: Slit lamp consists of

- Blue filter to look for fluorescence after staining with fluorescein dye
- Green filter to examine the nerve fiber layer of retina **(Figs 5.5 to 5.8)**.

Uses

- Anterior segment is examined by slit lamp by diffuse illumination, direct illumination, indirect illumination and retro illumination.
- Angle of the anterior chamber is examined by using gonio lens with slit lamp.
- Thickness of cornea is measured by using pachymeter with slit lamp.
- IOP is measured by using Goldmann Applanation tonometer with slit lamp.

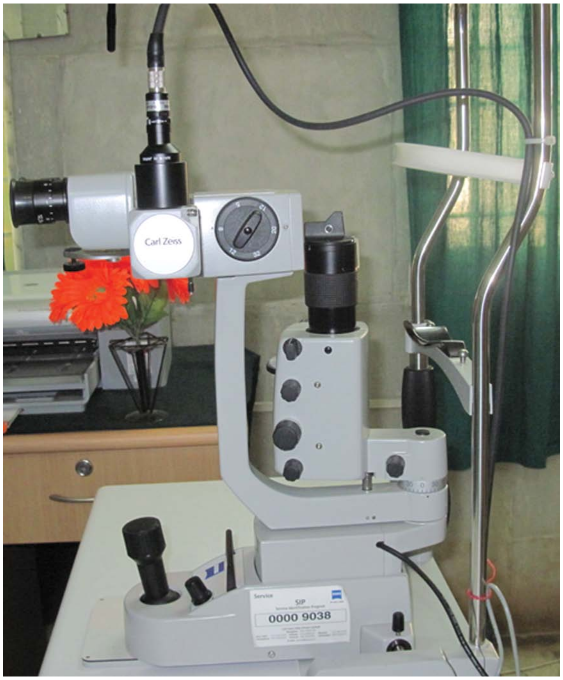


Fig. 5.5: Slit lamp

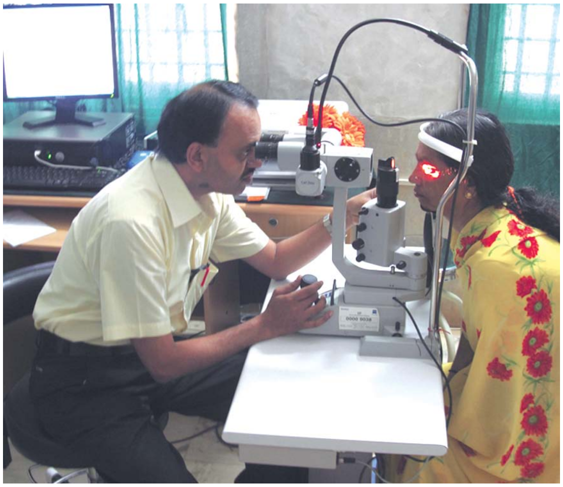


Fig. 5.6: Slit lamp examination

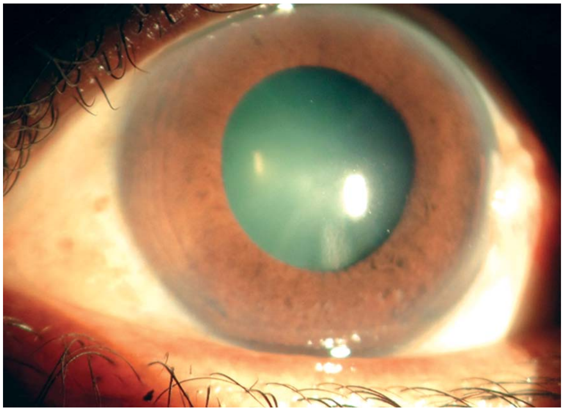


Fig. 5.7: Diffuse illumination

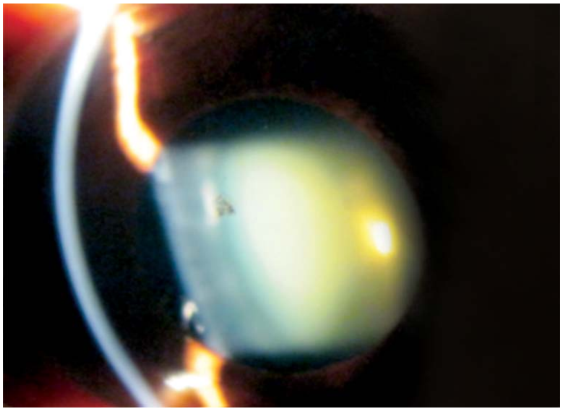


Fig. 5.8: Optical section (slit view)

Table 5.1: Differences between direct and indirect ophthalmoscopy

	Direct ophthalmoscopy	*Indirect ophthalmoscopy*
Procedure	Uniocular	Binocular
Dilatation of pupils	Not required/optional	Required
Patient posture	Patient sitting	Patient supine
Examiner	Standing infront	Standing at the head end
Examination distance	As close to patient as possible	At arm's length
Magnification	15 times	3–5 times
	Direct ophthalmoscopy	Indirect ophthalmoscopy
Image	Virtual and erect	Real and inverted
Condensing lens	Not required	Required
Area of field seen	Central fundus	Complete fundus
	(upto equator)	(up to oraserrata)
Uses	Only diagnostic purpose	Diagnostic + Therapeutic (for doing lasers)

- Retina is examined by slit lamp with accessories like +78 D lens, +90 D lens and -58.6 D lens.

OPHTHALMOSCOPY

Examination of the eye by ophthalmoscope is called as ophthalmoscopy **(Table 5.1)**.

Ophthalmoscopy is done for:

- Examination of vitreous and retina (fundus)
- To detect opacities in ocular media.

Direct Ophthalmoscopy

It is done by direct ophthalmoscope.

Technique: For ophthalmoscopy (all types) dark room/semi dark room is preferred as pupil dilates is dim light and the examination is easier.

Patient is seated and asked to see straight ahead.

Examiner stands on the side of the eye to be examined and uses the same side eye as that of patient, i.e. to examine right eye examiner stands on right side and uses his right eye.

Light from ophthalmoscope is directed into patient's pupil, after seeing red reflex examiner moves as close as possible to patient's eye (anterior focal length of eye 15 mm) and examines optic disk and macula.

Direct ophthalmoscope provides about 15 times magnification and the image formed is virtual and erect **(Figs 5.9 and 5.10)**.

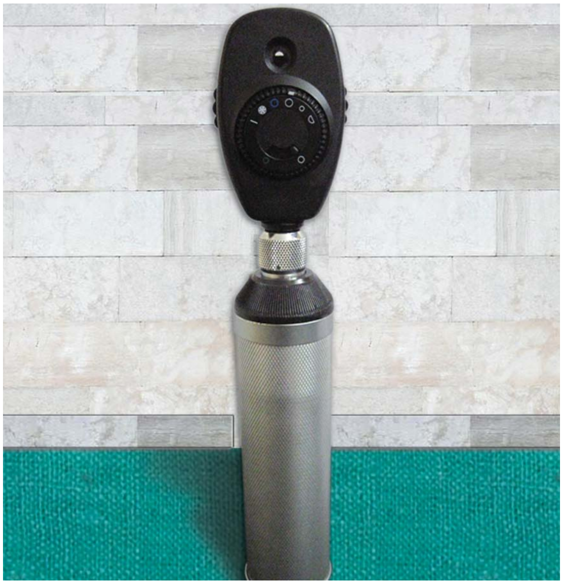
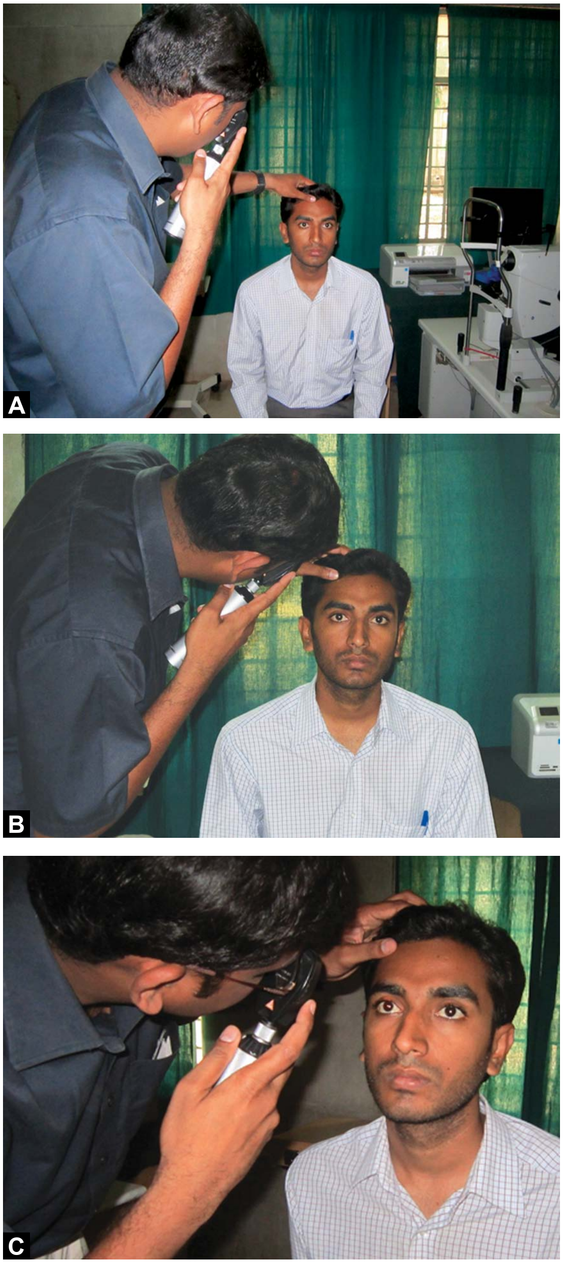


Fig. 5.9: Direct ophthalmoscope



Figs 5.10A to C: Procedure of direct ophthalmoscopy

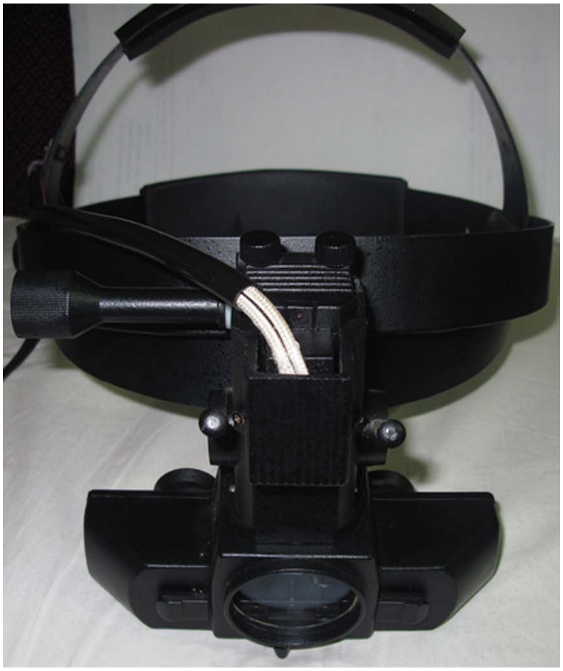


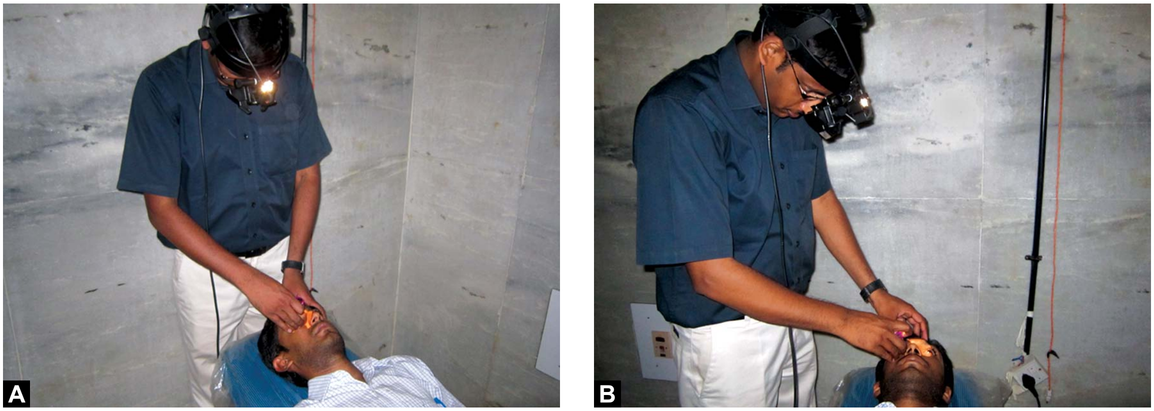
Fig. 5.11: Indirect ophthalmoscope

Indirect Ophthalmoscopy

It is done by indirect ophthalmoscope.

Technique:

- Pupils of the patient are dilated with tropicamide
- Patient is asked to lie in supine position
- Indirect ophthalmoscope is worn on the head, light is directed into patient's eye from a distance of an arm length and a +20 D lens is interposed in the path of the light so that when light is focused on the retina of patient an image is formed between the patient and the examiner.
- It provides 3 times magnification and the image formed is real and inverted.
- Image magnification = power of the eye/ power of the condensing lens (60/20 =3) **(Figs 5.11 and 5.12)**.



Figs 5.12A and B: Procedure of indirect ophthalmoscopy

Distant Direct Ophthalmoscopy

It is performed to detect opacities in the media. It is performed by direct ophthalmoscope or by a plain mirror.

Technique

Light is directed into patient's eye from a distance of 25 cm and the features of red glow are studied.

Any opacity in the media appears as black shadow. Any opacity in the pupillary plane will not move with movement of light, the opacity in front of pupillary plane moves in the same direction and the opacity behind the pupillary plane moves in opposite direction.

KERATOMETRY

Keratometry is the measurement of curvature of cornea by an instrument called as keratometer.

Keratometer is based on the fact that the anterior surface of cornea acts as convex mirror so that the size of the image produced varies with its curvature, hence from the size of the image corneal curvature can be estimated. Javal Schiotz keratometer and Bausch and Lomb keratometer are used in clinical practice **(Figs 5.13 and 5.14)**.

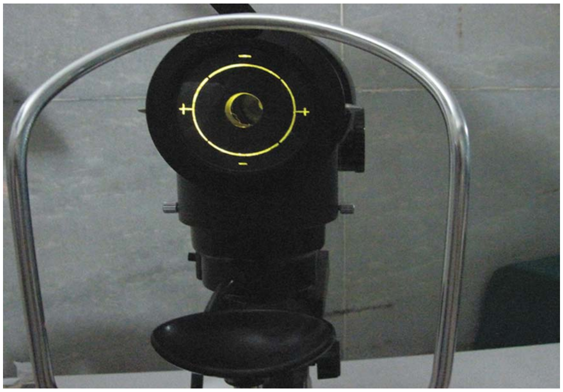
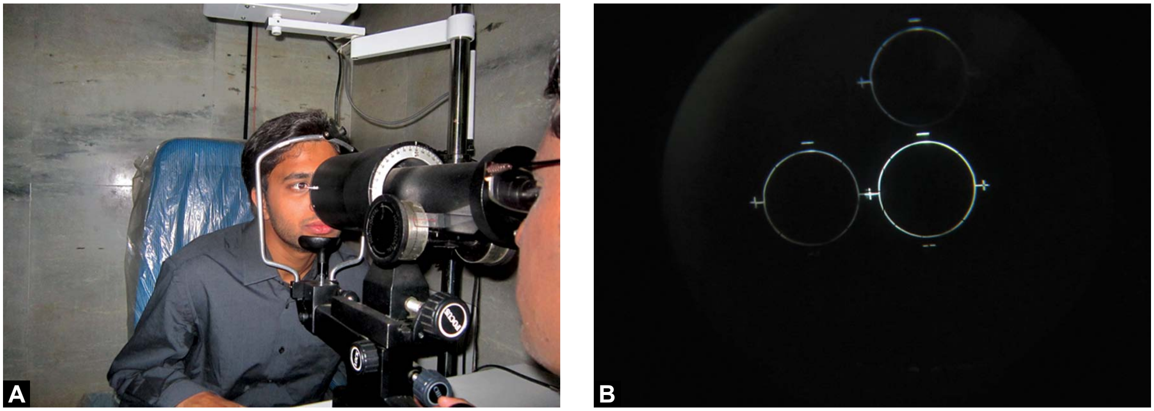
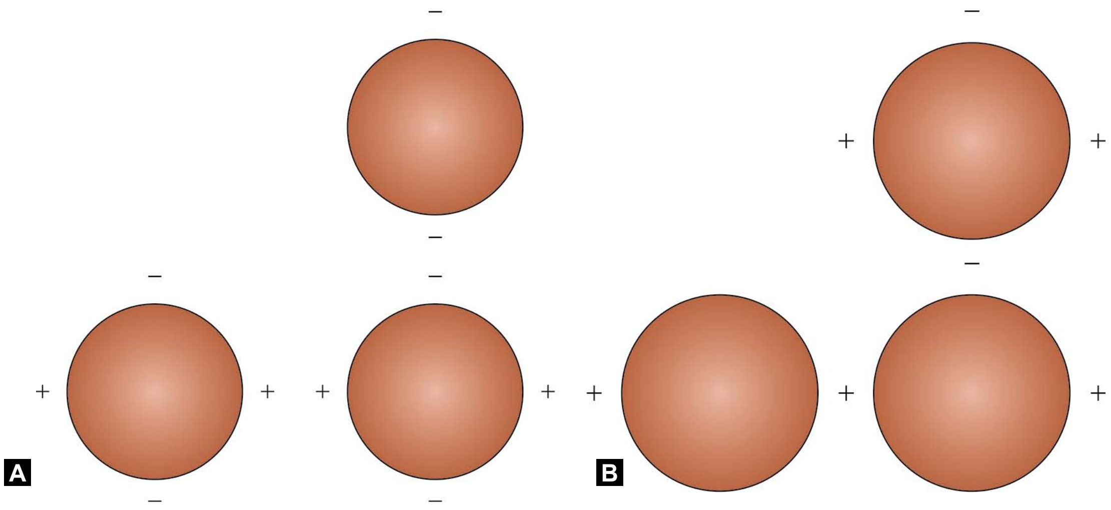


Fig. 5.13: Mires of keratometer (Bausch and Lomb)

In Bausch and Lomb (B and L) keratometer mires consists of a circle with two plus signs in horizontal meridian and two minus signs in vertical meridian. This is projected on to the patient's cornea, on which the reflected image is formed (first Purkinje image). Because of presence of doubling prisms in the objective the examiner sees three images, one image to side, one image above the original image **(Figs 5.15A and B)**. Corneal curvature is measured by aligning two plus signs for horizontal meridian and aligning two minus signs for vertical meridian.



Figs 5.14A and B: (A) Procedure of keratometry; (B) Mires as seen on subjects cornea



Figs 5.15A and B: (A) B and L keratometer mires before alignment; (B) B and L keratometer mires after alignment

Uses

In measurement of corneal curvature (Kreading) for

- Calculation of IOL power
- Contact lens fitting to measure radius of curvature
- Diagnosis of keratoconus and monitoring its progress
- Measurement of astigmatism of cornea.

RETINOSCOPY

Objective method of finding the refractive error by utilizing the technique of neutralization is called as retinoscopy.

Principle

When light is reflected into eye, the direction in which light will travel in the pupillary area depends on the refractive status of the eye.

Retinoscopy is performed in a dark room (6 meters long or a 3 meters room converted into 6 meters by plane mirror) with trial set consisting of spherical and cylindrical lenses, trial frame, distance vision chart, near vision chart and retinoscope.

Retinoscope

It is an instrument used to do retinoscopy.

Two types of retinoscopes are available.

1. Mirror retinoscope (Pristley-Smith mirror) consists of a combination of plane and concave mirrors.
2. Self, illuminated retinoscopes, Streak retinoscope and Spot retinoscope.

Procedure

It is done from a distance of 1 m from the patient. Light is thrown into patient's eye and the examiner observes the red reflex in the pupillary area and its movement in horizontal and vertical meridian by moving the retinoscope. The results are interpreted as

No, movement of red reflex—indicates myopia of 1 D

- Movement of red reflex against the movement of the retinoscope—myopia of >1 D
- Movement of red reflex with the movement of the retinoscope—emmetropia, myopia <1 D and hypermetropia.

The refractive error is estimated by neutralizing the movement of red reflex in both vertical and horizontal meridian.

Red reflex when moving against the movement, concave lens of appropriate power is used to neutralize red reflex (concave lens makes the image to move in same direction).

Red reflex when moving with the movement, convex lens of appropriate power is used to neutralize red reflex (convex lens makes the image to move in opposite direction).

Cycloplegic agents are used in retinoscopy when accommodation is active as in children and in hypermetropia which may not allow exact calculation of refractive error.

Choice of cycloplegic agent:
Children <7 years—Atropine
Adults between 7 and 35 years with hypermetropia—Homatropine/cyclopentolate
Elderly patients—Only mydriatic like Phenyl ephrine or Tropicamide to enhance visibility of pupillary reflex

Postmydriatic Test

Testing of the objective refraction for subjective correction is done in postmydriatic test. It is done when mydriatic/cycloplegic agent is used for doing retinoscopy.

Postmydriatic test is done after the action of cycloplegic has completely disappeared, i.e.
Atropine—after 3 weeks

- Homatropine—after 3 days
- Cyclopentolate—after 1 day
- Phenyl ephrine or tropicamide—same day after 4 hours.

On the day of PMT deductions are done for cycloplegic used and for the distance of retinoscopy from the retinoscopy readings.

Deduction for cycloplegic agents is as follows:

- Atropine–1D
- Homatropine–0.5 D
- Cyclopentolate–0.75 D
- Phenyl ephrine–0 D.

Deduction for distance:
1 meter-1 D
2/3 meter-1.5 D

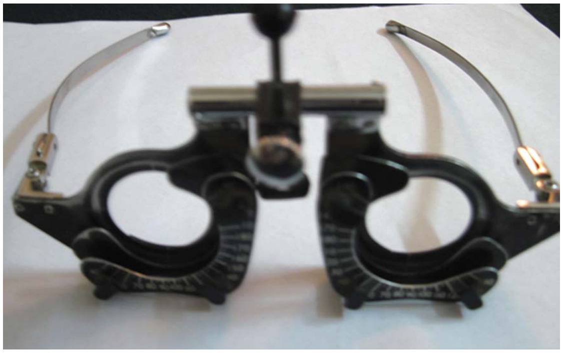


Fig. 5.16: Keratometer

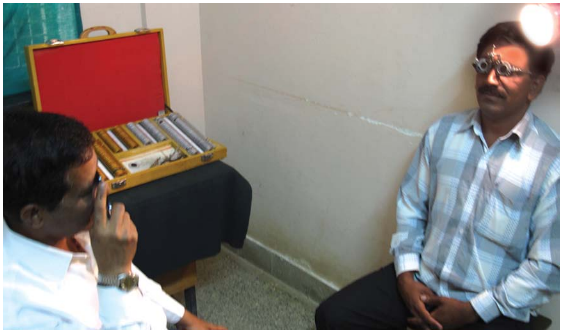


Fig. 5.17: Procedure of retinoscopy

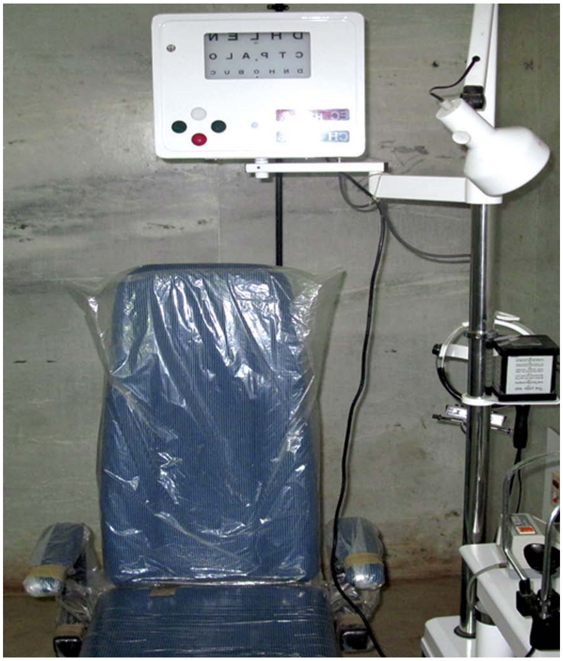
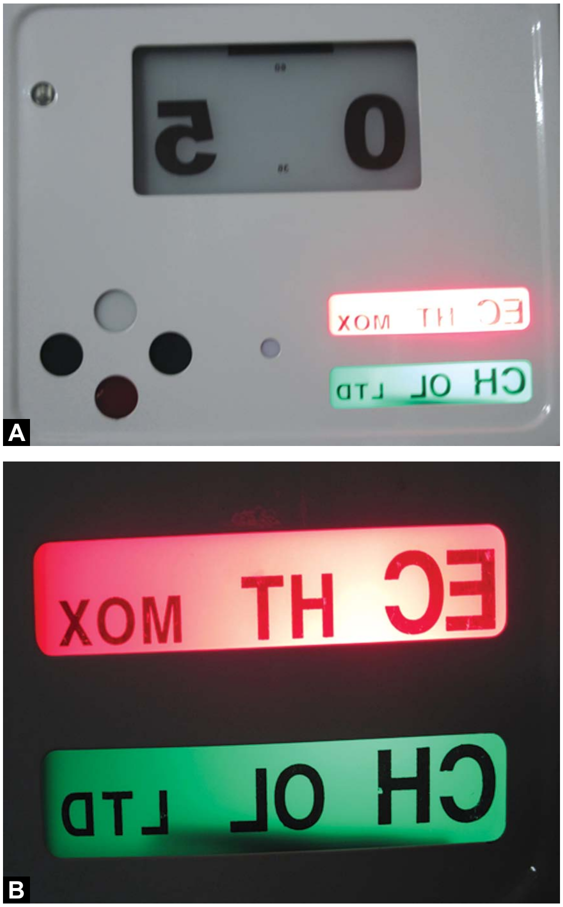


Fig. 5.18: Ophthalmic chair unit with Snellen's chart

Refractive error = retinoscopy finding - deduction for cycloplegia - deduction for distance.



Figs 5.19A and B: Red and green letters for duochrome test

Duochrome test: It is done after giving correction for refractive error to assess under correction or over correction.

It is based on chromatic aberration, ie.normally in emmetropic condition red rays are focused posterior to retina and green rays are focused anterior to the retina, hence emmetropic person sees both colors equally sharp.

In this test patient is asked to read letters with red and green background.

If the patient appreciates red better than green it indicates correction is slightly myopic and if the patient appreciates green better than red it indicates correction is slightly hypermetropic. Refractive power should be adjusted till he sees both letters equally sharp.

Red and green letters are incorporated in snellen chart for doing this test at the end of refraction and correction **(Figs 5.19A and B)**.

Worth's four dot test: It is done in cases of anisometropia to assess the status of binocular vision.

It is done from a distance of 6 meters. Patient wears red green goggles with red infront of right eye and green infront of left eye and sees the four dots (one red, two green and one white dot) which are incorporated in snellen's chart. The results of the test are interpreted as below.

Patient sees four lights—normal binocular vision.

Patient sees only two red lights—left eye suppression.

Patient sees only three green lights—right eye suppression.

Patient sees two red lights and three green lights alternatively—alternate suppression.

Patient sees five lights two red and three green–diplopia.

Patient sees four lights in the presence of squint—abnormal retinal correspondence **(Figs 5.20A and B)**.

Friend test: The word FRIEND is usually incorporated in the snellen's chart at the bottom, the letters F, I, N are in green and the letters R, E, D are in red.

This can be used to do duochrome test and as an alternative to worth's four dot test to check for binocular single vision.

To check for duochrome test patient is asked to compare which color letters he is able to appreciate better and the results are interpreted as follows:

If the patient appreciates red letters R,E,D than F, I, N, it indicates correction is slightly myopic and if the patient appreciates green letters F,I,N better than red letters R, E, D, it indicates correction is slightly hypermetropic. His refractive power should be adjusted till he sees both letters equally sharp.

To test binocular vision patient wears red green goggles with red infront of right eye and green infront of left eye and the findings are interpreted as:

Patient sees FRIEND at once—normal binocular vision

Patient sees only RED—left eye suppression

Patient sees only FIN—right eye suppression

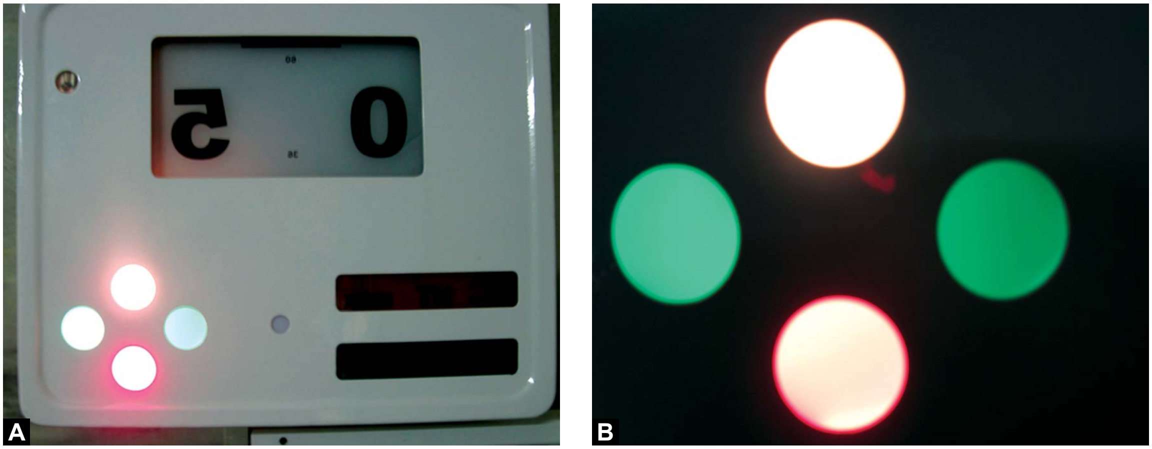
Patient sees FIN and RED alternatively—alternate suppression **(Fig. 5.21)**.

GONIOSCOPY

Examination of angle of the anterior chamber by goniscope is called as gonioscopy.

Types

Direct gonioscopy is done by direct goniolens like Koeppe goniolens which gives direct view of the angle.



Figs 5.20A and B: Two green, one white and one red dot for Worth's four dot test

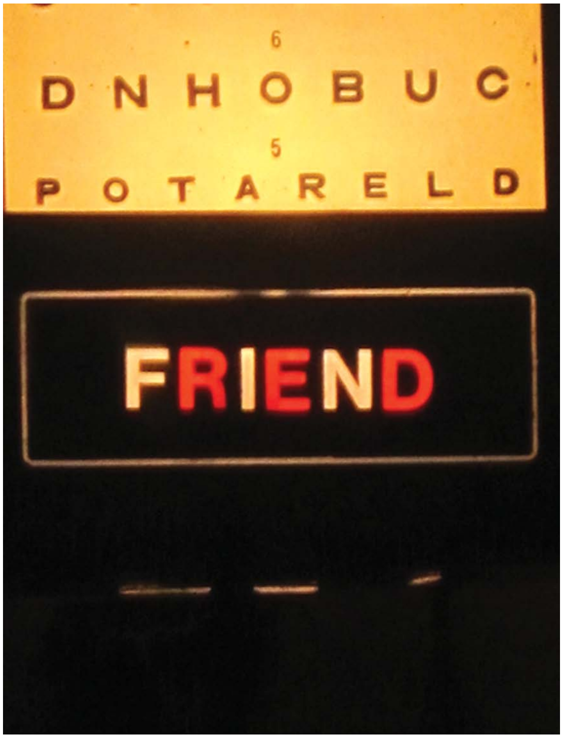


Fig. 5.21: Friend test

Indirect gonioscopy done by gonioprism or mirror like Goldmann 3-mirror or 2-mirror or 1-mirror (Figs 5.22A and B) and Zeiss-4 mirror, which give mirror image of the opposite angle.

Uses

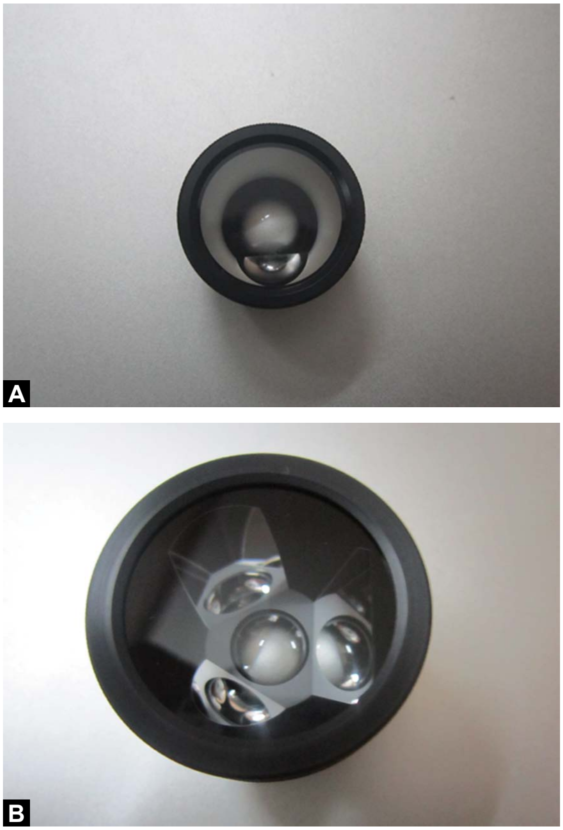
For evaluating a patient of glaucoma. Based on this glaucoma is classified as open angle or narrow angle.

For evaluating patients with blunt trauma to look for injuries to angle of anterior chamber like angle recession, foreign bodies lodged in angle of anterior chamber.

PERIMETRY

Measurement of visual fields by projecting targets on to a curved surface is called as perimetry.

Visual field is an area that one eye can see while the eye fixed on a target. Normal visual field is superiorly and nasally 60 degrees, inferiorly 70 degrees and temporally 90 degrees.



Figs 5.22A and B: (A) Goldmann single mirror; (B) Goldmann three mirror

Kinetic Perimetry

Stimulus of known luminance is moved from periphery towards center. For examples, Confrontation method, Lister's perimetry, Goldmann perimetry.

Static Perimetry

Stimulus at a fixed spot is presented by varying luminance.

For example, Automated perimetry.

Commonly used automated perimeters are Octopus and Humphrey field analyzer.

Uses

Visual fields are used in evaluating lesions of optic nerve.

The most common indication for doing visual fields is to study the progression of glaucoma.

ULTRASONOGRAPHY

Ultrasound waves in the range of 10 MHz are used for ophthalmic diagnosis. This is based on pulse echo technique.

Ultrasonic waves passing through a medium are returned back to their source when they encounter a change in density. The reflected echoes are studied to identify pathologies inside the eye.

A-scan: Time amplitude ultrasonography.

This produces a unidimensional image plotted as spikes. The height of the spike indicates the density of the tissue and the distance of the spikes is used for calculation of distance between interfaces. The height of retinoscleral spike is considered as normal standard and other spikes are graded as small or moderate amplitude. A metallic foreign body in the vitreous or retina gives supranormal spikes. Vitreous hemorrhage produces very low spikes.

Uses

For calculation of axial length for calculation of IOL power **(Figs 5.23 and 5.24)**.

B-scan: Bidimensional brightness scan.

This produces two dimensional image plotted as dots and the brightness of dots indicates the size of the received echo.

Uses: Assessment of posterior segment in the presence of opaque media and for evaluating vitreoretinal and orbital mass lesions.

C-scan (Coronal scan): This is similar to B-scan differing from B-scan by the fact that here echoes are recorded from coronal plane thus C-scan displays soft tissues in the coronal plane of the orbit.

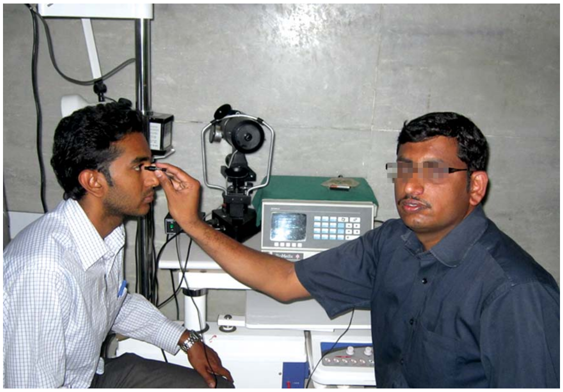


Fig. 5.23: A-scan

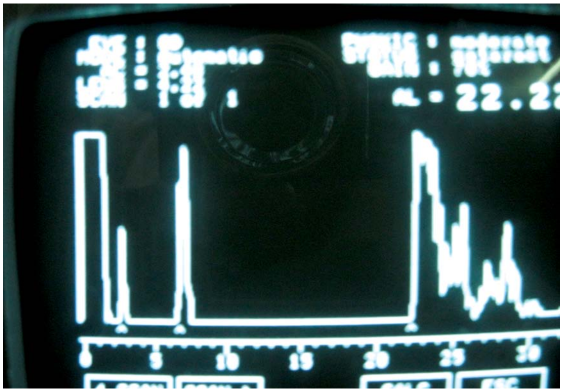


Fig. 5.24: Spikes of A-scan

ULTRASOUND BIOMICROSCOPY

In Ultrasound biomicroscopy (UBM) higher frequencies 50–100 MHz providing higher resolution (roughly it equals to that provided by microscope, i.e. about 50 microns hence called as ultrasound biomicroscopy). But the penetration of UBM is only up to 5 mm hence only structures of the anterior segment can be examined.

Uses

Evaluation of mass lesions of anterior segment. Examination of anterior chamber depth, angle of anterior chamber…..

VITAL STAINS

- Fluorescein
- Rose bengal
- Lissamine green.

Fluorescein stains epithelial defects. It is appreciated better under blue filter of the slit lamp as it is appears brilliant green due to fluorescence.

Rose bengal and lissamine green stain devitalized cells.

Fluorescein is a large molecule, which will not cross tight junctions of intact epithelium and hence it stains epithelial defects.

Rose bengal and lissamine green being smaller than fluorescein, can penetrate intact epithelium and stain devitalized epithelial cells.

Rose bengal causes more ocular irritation than lissamine green, hence, lissamine green can be used in its place when patient is not able to tolerate rose bengal.

Uses of Vital Stains

- Vital staining is used for evaluation of a patient with dry eye.
- Tear film break up time (T-BUT) using fluorescein
- Rose bengal staining.

T-BUT: Tears are stained with fluorescein dye and the time interval between a complete blink to the appearance of first dry spot in the tear film is T-BUT.

- Normal 15–30 seconds
- Abnormal <5 seconds.

Rose Bengal Staining

Eye is stained with Rose bengal. Ocular surface is divided into three zones:

1. Cornea
2. Nasal bulbar conjunctiva and
3. Temporal bulbar conjunctiva.

Each zone is evaluated for the density of stain and given score of:

- 0-none
- 1-mild staining
- 2-moderate staining
- 3-severe staining.

A total score of >3.5 is taken as positive for dry eye.

Fluorescein

Fluorescein is an orange water soluble dye. It exhibits the property of fluorescence.

Fluorescence is the property of molecules to emit light energy of a longer wavelength when stimulated by a light of shorter wave length.

Fluorescein responds to light energy between 465 and 490 nm (blue light) and fluorescence at a wave length of 520–530 nm (green light). Hence, if blue light is directed at fluorescein it emits green light. Because of this property of fluorescence, fluorescein is better appreciated under blue filter of slit lamp.

Uses of fluorescein:

For identification of corneal epithelial defects by fluorescein staining.

For examination of corneal ulcer to study morphology of the ulcer

In dry eye evaluation for performing T-BUT.

In evaluation of patient with watering eye for fluorescein dye disappearance test and Jones tests.

Seidel's test to identify leak from anterior chamber (in traumatic corneal tear or postoperative shallow anterior chamber after cataract surgery). Fundus fluorescein angiography to study retinal and choroidal circulation.

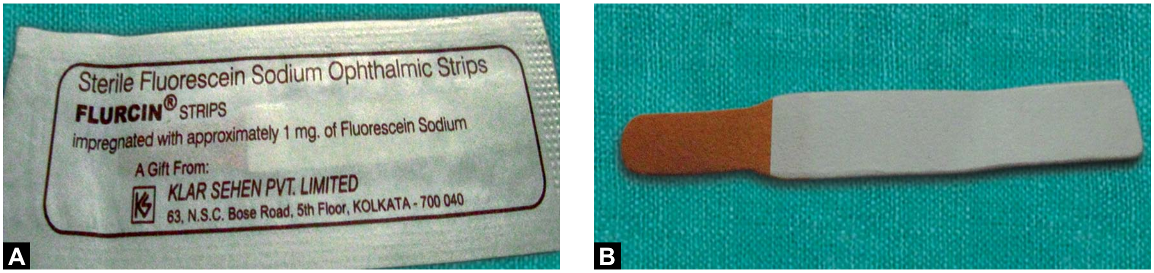
Other dyes used in ophthalmology

Indocyanine green used for indocyanine green angiography.

Trypan blue used to stain anterior capsule in cataract surgery for performing capsulorrhexis.

Seidel's test

It is done under slit lamp. The suspected site of wound leak is stained with fluorescein and the fluorescein pattern is observed for dilution which indicates leak of aqueous (aqueous if leaking mixes with fluorescein there by diluting fluorescein) from anterior chamber **(Figs 5.25 to 5.28)**.


Sterile Fluorescein Sodium Ophthalmic Strips
FLURCIN® STRIPS
impregnated with approximately 1 mg. of Fluorescein Sodium
A Gift From:
KLAR SEHEN PVT. LIMITED
63, N.S.C. Bose Road, 5th Floor, KOLKATA - 700 040
A
B

Figs 5.25A and B: Fluorescein strip

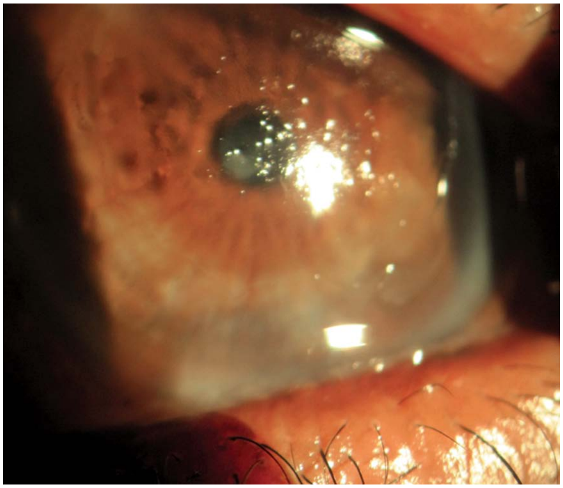


Fig. 5.26: Under diffuse light

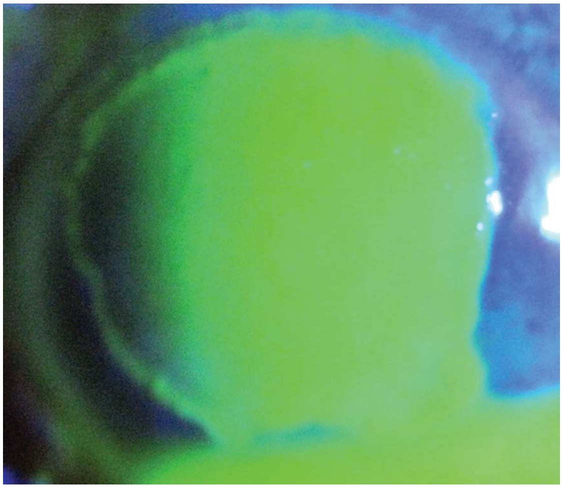


Fig. 5.28: Under blue light after staining with fluorescein

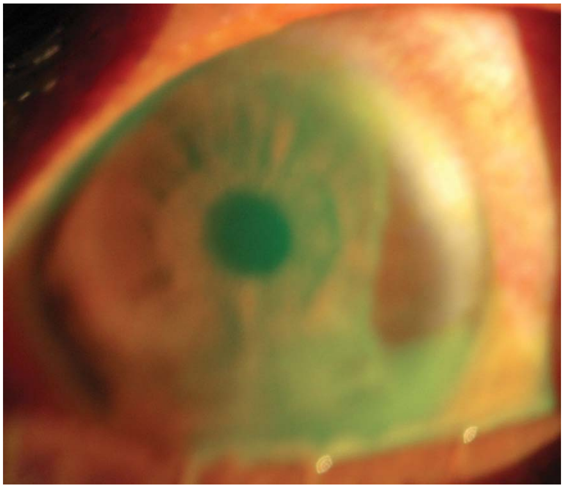


Fig. 5.27: Under diffuse light after staining with fluorescein

SPECULAR MICROSCOPY

Specular microscope is a reflected microscope which employs the technique of specular reflection, i.e. where angle of incidence is equal to angle of reflection to study corneal endothelium **(Fig. 5.29)**.

Uses

- Evaluation of donor corneal endothelium in eye bank
- Early diagnosis of endothelial dystrophies like Fuch's endothelial dystrophy.

FUNDUS FLUORESCEIN ANGIOGRAPHY

It is photographic surveillance of the passage of fluorescein through the retinal and choroi-

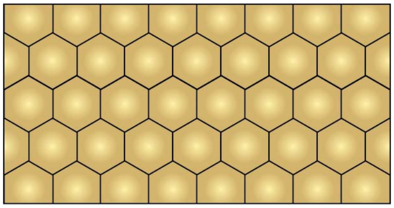


Fig. 5.29: Normal hexagonal corneal endothelium as seen on specular microscopy

dal circulations after fluorescein is injected into antecubital vein.

Fluorescein (5 ml of 10% or 10 ml of 5%) is injected into antecubital vein and photos aretaken with a fundus camera after 5 seconds every second for next 20 seconds and every 5 seconds for next one minute.

Normally, fluorescein does not cross the blood retinal barrier and it rapidly diffuses through the choriocapillaries. The photographs are studied for hyperfluorescence and hypofluorescence.

Hypofluorescence is seen in blockage of arteries, veins, capillaries like artery occlusion and filling defects of the veins.

Hyperfluorescence is seen because of leakage of dye as in diabetic retinopathy, central serous retinopathy.

Uses

In retinal disorders like:
- Diabetic retinopathy
- Central serous retinopathy (ink blot pattern and smoke stack pattern)
- Cystoid macular edema (flower petal appearance)
- Vein/artery occlusions of retina
- Eales disease, ARMD **(Figs 5.30 and 5.31)**.

INDOCYANINE GREEN ANGIOGRAPHY

Indocyanine dye remains in the choriocapillaries in contrast to fluorescein which extravasates from choriocapillaries, hence it allows imaging of choroid.

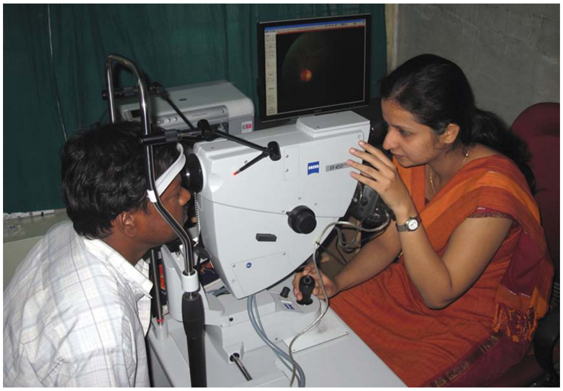


Fig. 5.30: Fundus camera and fundus photography

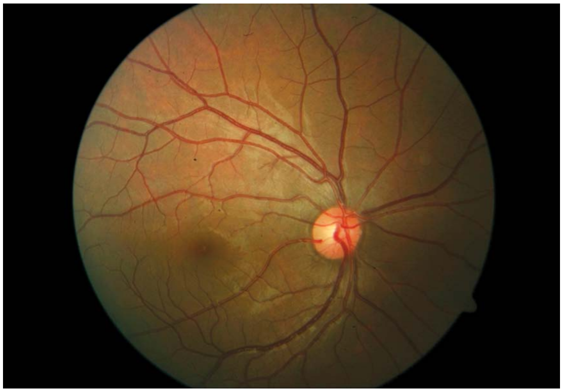


Fig. 5.31: Fundus photograph

Uses

For diagnosis of choroidal disorders like choroidal neovascularization, polypoidal choroidal vasculopathy.

OPTICAL COHERENCE TOMOGRAPHY

Optical coherence tomography (OCT) permits high resolution cross-sectional imaging of retina using coherence light.

Uses

For examination of macular diseases like macular hole, macular edema, epiretinal membrane, central serous retinopathy, age-related macular degeneration, vitreomacular traction syndrome.

For measurement of nerve fiber layer thickness in patients with glaucoma for assessment of glaucoma.

HEIDELBERG RETINAL TOMOGRAPH

It is a confocal scanning laser ophthalmoscopy for imaging of optic nerve head and nerve fiber layer.

Uses

In patients with glaucoma/glaucoma suspects for early detection of glaucomatous damage and progression.

CORNEAL TOPOGRAPHY

Analysis of corneal shape (curvature) is done by corneal topography.

Uses

For diagnosis and monitoring the progression of keratoconus.

It is a mandatory test before refractive surgeries.

ELECTROPHYSIOLOGICAL TESTS

These tests are done for objective evaluation of the retinal functions.

Electroretinography

It is the record of electric potential changes in the retina induced by a flash of light. It depicts the response of the outer layer of the retina.

Uses

In detecting functional abnormalities of the outer retina before ophthalmoscopic signs appear. Electroretinography (ERG) is useful in diagnosis of diseases which involve outer retina like retinitis pigmentosa and other chorioretinal degenerations.

It is done as retinal function test when fundus examination is not possible because of opacities in the media.

Electro-oculography

It measures the resting potential between cornea and back of the eye. It has similar uses as to that of ERG.

Visually Evoked Potential

It measures the changes in the resting potential induced by a flash of light at the occipital lobe.

Uses

It is used to objectively assess the functional state of the visual system beyond the retinal ganglion cells.

RETINAL FUNCTION TESTS

Described under cataract.

MACULAR FUNCTION TESTS

Described under cataract.

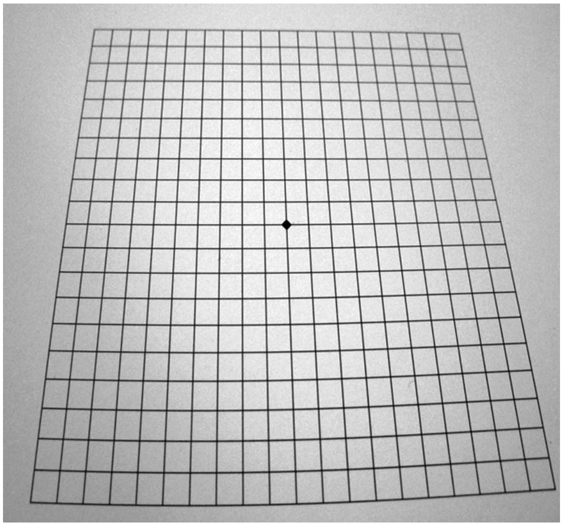


Fig. 5.32: Amsler's grid consists of 400 small squares with a central fixation point. Patient is asked to close one eye and to see at Amsler's chart with the other eye, holding the chart at normal reading distance. Patient is asked to look for any distortion in the grid while looking at the central fixing dot. Distortion indicates macular pathology. The test is repeated in the other eye

TESTS FOR EVALUATION OF A CASE OF WATERING EYE

Described under dacryocystitis case presentation.

TESTS FOR EVALUATION OF A CASE OF SQUINT

Hirschberg Corneal Reflex Test

- It is a rough method for estimation of amount of squint
- Patient is asked to fixate at a point light held at a distance of 33 cm, normally corneal light reflex (Purkinje first image) is at the center of the pupil
- Each millimeter of shift of corneal light reflex from center of pupil is equal to 7.5 degree or 15 prism diopters of squint
- In esotropia the light reflex falls on the temporal side as the eyeball is deviated nasally and reverse in case of exotropia
- Light reflex at pupillary margin = 2 mm shift of corneal reflex = 15 degrees
- Light reflex in between pupillary margin and limbus = 4 mm shift = 30 degrees
- Light reflex at limbus = 6 mm shift of corneal reflex = 45 degrees.

Cover Test (Fig. 5.34)

It is done to detect the presence of manifest squint and to differentiate it from pseudosquint.

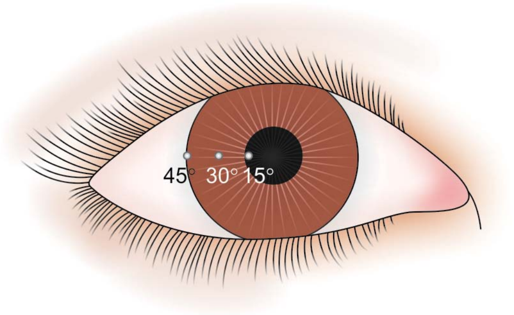


Fig. 5.33: Hirschberg corneal reflex test

It is performed both for near and distance (patient fixing at a target of 33 cm for near and 6 meters for distance).

Normal eye (undeviated eye) is covered and the movement of deviated eye is noted.

No movement of the uncovered eye pseudosquint, i.e. no squint (orthophoria).

Inward movement of the uncovered eye (outward deviated eye)–exotropia.

Outward movement of the uncovered eye (inward deviated eye)–esotropia.

Downward movement of the uncovered eye (upward deviated eye)–hypertropia.

Upward movement of the uncovered eye (downward deviated eye)–hypotropia.

Cover-Uncover Test (Fig. 5.35)

- It is done to detect latent squint
- It is performed both for near and distance

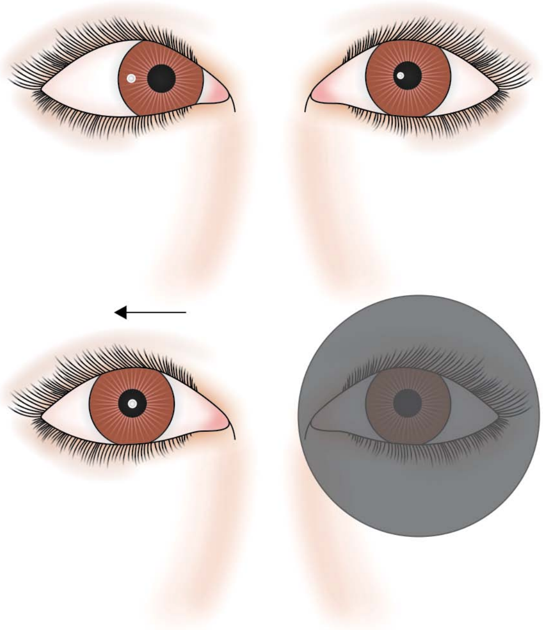


Fig. 5.34: Cover test. *Note:* Outward movement of uncovered eye, on covering normal eye

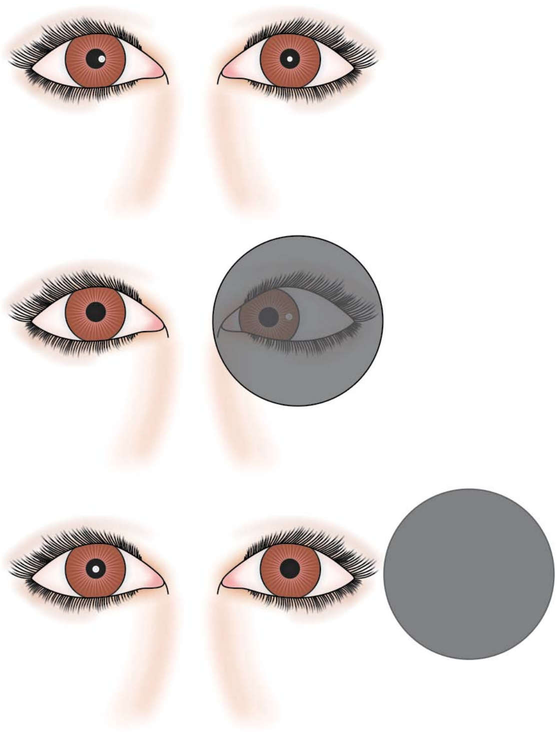


Fig. 5.35: Cover-uncover test. *Note:* Outward refixation movement of eye under cover—esophoria

- Here the eye is covered for less than 2 seconds and the cover is removed and the refixation movement of eye under cover is observed
- No movement of the eye under cover—orthophoria
- Inward refixation movement of the eye under cover—exophorpia
- Outward refixation movement of the eye under cover—esophoria.

Alternate Cover Test

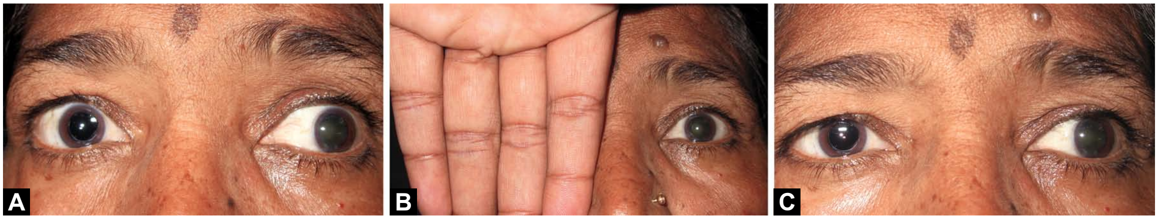
It is done to detect total squint, i.e. manifest squint+latent squint.

It is performed both for near and distance.

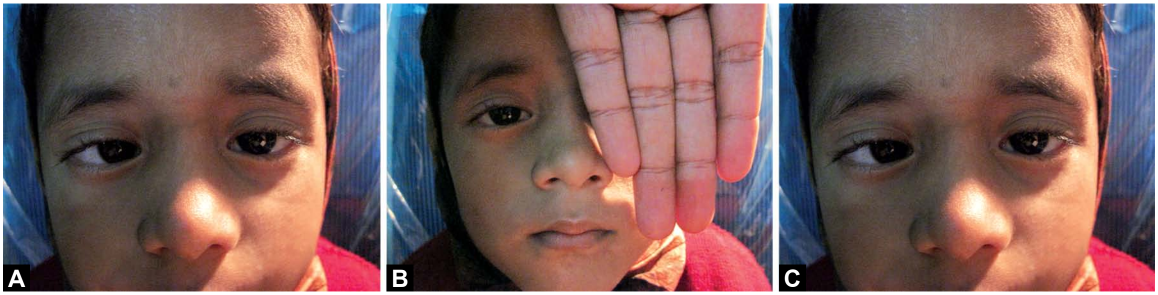
Here eye is covered for more than 2 seconds and the cover is immediately shifted to other eye while observing the movement of the covered eye, this is repeated several times. The principle is to break fusion and to make the latent squint to manifest, hence it measures the total amount of squint or deviation.

In cover test the movement of uncovered eye is observed. It is done to detect tropia or manifest squint. In cover-uncover test refixation movement of covered eye is observed. It is done to detect phoria or latent squint.

In alternate cover test refixation movement of the covered eye is observed. It is done to detect total squint (phoria+tropia).



Figs 5.36A to C: Cover test for exotropia. *Note:* (A) Left eye-Exotropia (deviated outwards); (B) On covering RE, LE takes fixation; (C) On uncovering RE, LE deviates again



Figs 5.37A to C: Cover test for esotropia: (A) Right eye—Esotropia (deviated inwards); (B) On covering LE, RE takes fixation; (C) On uncovering LE, RE deviates again

Prism Bar Cover Test

Prisms of increasing strengths are placed infront of one eye with apex of the prism directed towards the deviation. Cover test and cover-uncover test are done till there is no refixation movement of the eye under cover. The strength of the prism at this point gives the amount of deviation **(Fig. 5.38)**.

Krimsky Corneal Reflex Test

Prisms of increasing strengths are placed infront of one eye with apex of the prism directed towards the deviation, till the Hirschberg corneal reflex test is centered. The strength of the prism at this point gives the amount of deviation.

Maddox Wing Test

Maddox wing works by presenting dissimilar images to two eyes there by breaking fusion and thus measures phoria (latent squint).

It is done from a distance of 33 cm hence it measures phoria for near.

The instrument is constructed in such a way that the right eye sees only white vertical arrow and a red horizontal arrow, the left eye sees only horizontal and vertical rows of numbers. The patient is asked to tell the number on the horizontal line which the vertical white arrow is pointing to measure the horizontal deviation.

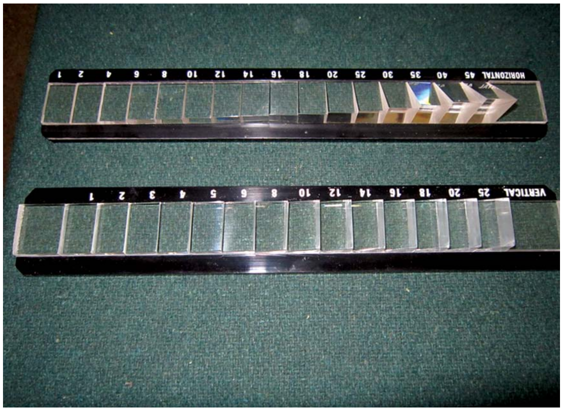


Fig. 5.38: Prism bars

Vertical deviation is measured by asking the patient to say the number on the vertical line pointedby red arrow. The amount of cyclophoria is calculated by asking the patient to align the arrow with horizontal line of numbers.

Maddox Rod Test

Maddox rod consists of a series of parallel high power plus cylinders that convert point light as a red straight line at right angle to the axis of the rod.

It also works by presenting dissimilar images to two eyes there by breaking fusion and thus measures phoria (latent squint).

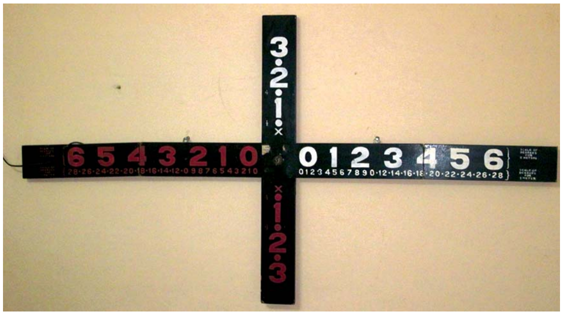


Fig. 5.39: Maddox tangent scale

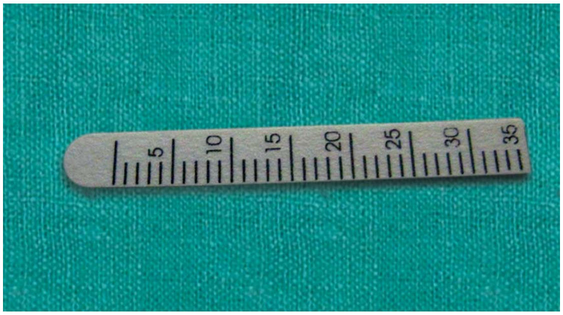


Fig. 5.40: Schirmer's test strip

It is done from a distance of 6 m hence it measures phoria for distance.

Maddox rod is placed infront of the right eye and asked to see point source of light. This dissociates the two eyes as he will be seeing red line in right eye and a point source of light in left eye. The number on Maddox tangent scale where the red line falls gives the amount of heterophoria in degrees **(Fig. 5.39)**.

TESTS FOR EVALUATION OF TEAR FILM

Schirmer's Test (Fig. 5.40)

Schirmer's test I: It measures the total tear secretions.

- It is performed by a schirmer's test strip, (a whatman filter paper 5 by 35 mm strip) which is folded at 5 mm and kept in lower conjunctival fornix. The test strip is kept in the lower fornix for 5 minutes and the amount of wetting on the filter paper is noted.
- Wetting up to or more than 15 mm—normal
- Wetting between 10 and 15 mm—borderline or mild dry eye
- Wetting between 5 and 10 mm—moderate dry eye
- Wetting <5 mm—severe dry eye.

Schirmer's test II: It is done to measure reflex secretions.

It is performed in similar way as first test except that nasal mucosa is rubbed by a cotton bud to irritate it to measure reflex secretions.

Schirmer's Basal Secretion Test

It is performed similar to test I except that conjunctival fornix is anesthesized before performing the test.

Tear film break up time: Described under vital staining.

Vital staining: Described under vital staining.

CHAPTER

6

OPHTHALMIC INSTRUMENTS

CHAPTER OUTLINE

- Lid Speculum
- Needle Holder
- Forceps
- Scissors
- Knives (Blades)
- Instruments for Incision and Curettage of Chalazion
- Instruments for Lens Removal
- Instruments for Irrigation and Aspiration of Cortical Matter During Cataract Surgery
- Instruments for Enucleation
- Instruments for Evisceration
- Instruments for Lacrimal Sac Surgery
- Hooks and Retractors
- Castroviejo Calipers
- Iris Repositor
- Cystitome or Capsulotome

LID SPECULUM

It is used to keep the lids apart during surgeries on eyeball like pterygium excision, corneal surgeries, glaucoma surgeries and cataract surgery.

Minor outpatient procedures like corneal foreign body removal and scraping of corneal ulcer.

It is called as universal speculum because it can be used for both right and left eyes. It has to be inserted with open end facing medial canthus and the closed end towards the lateral canthus **(Figs 6.1 to 6.3)**.

NEEDLE HOLDER

Needle holders are meant to grasp needles during suturing.

Stevens Needle Holder and Arruga's Needle Holder

These are larger in size and have a locking mechanism **(Fig. 6.4)**.

These are meant for holding the needle for suturing during extraocular procedures like lid surgeries and for passing superior rectus bridle suture.

Barraquer and Castroviejo Needle Holder

These are used for holding the needle during suturing conjunctiva, cornea, sclera and extraocular muscles **(Fig. 6.5)**.

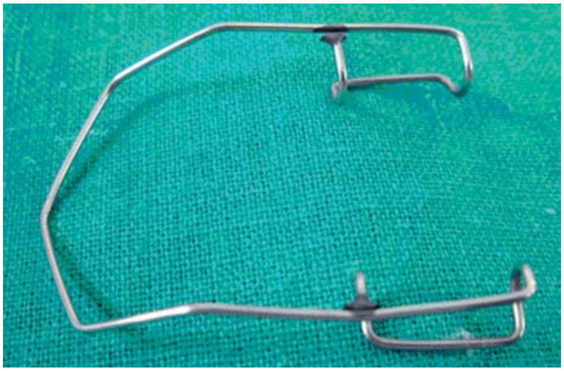


Fig. 6.1: Barraquer wire speculum

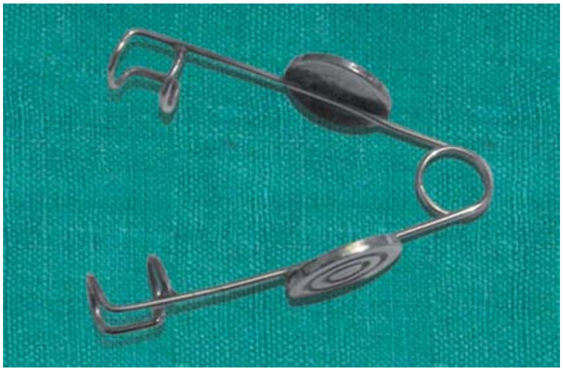


Fig. 6.3: Pediatric speculum

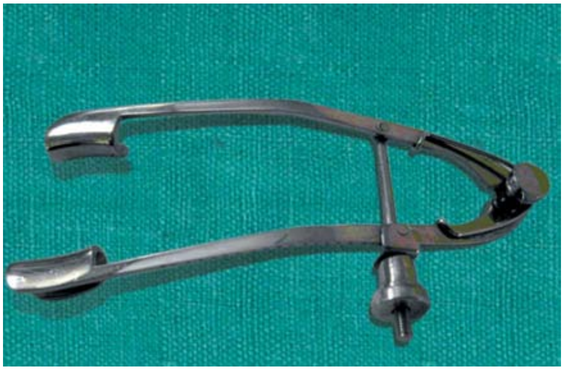


Fig. 6.2: Wire speculum with spring mechanism and solid blades

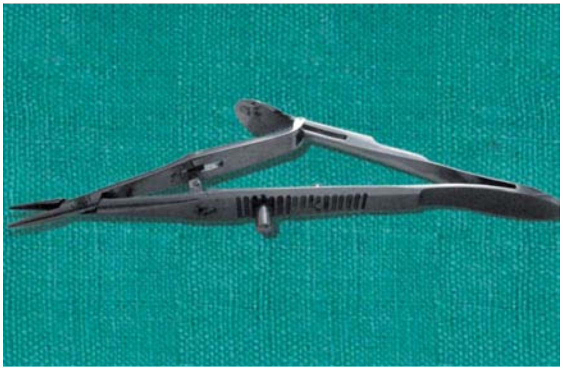


Fig. 6.4: Stevens needle holder

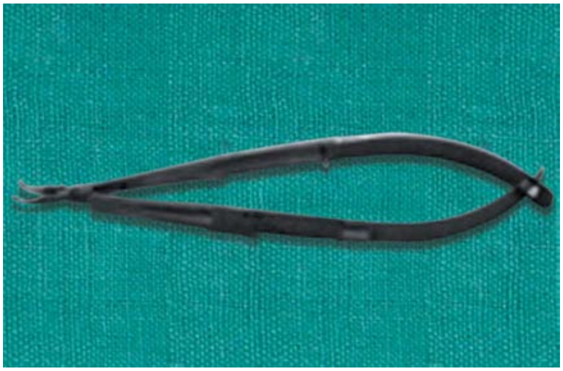


Fig. 6.5: Barraquer needle holder

FORCEPS

These are instruments designed for holding tissues and sutures.

Superior Rectus Holding Forceps

It is toothed forceps with S-shaped double curve near the tip **(Figs 6.6A and B)**.

It is used to hold superior rectus muscle for passing bridle suture for fixation of globe to stabilize eyeball during intraocular surgeries like cataract surgery, corneal surgery and glaucoma surgery.

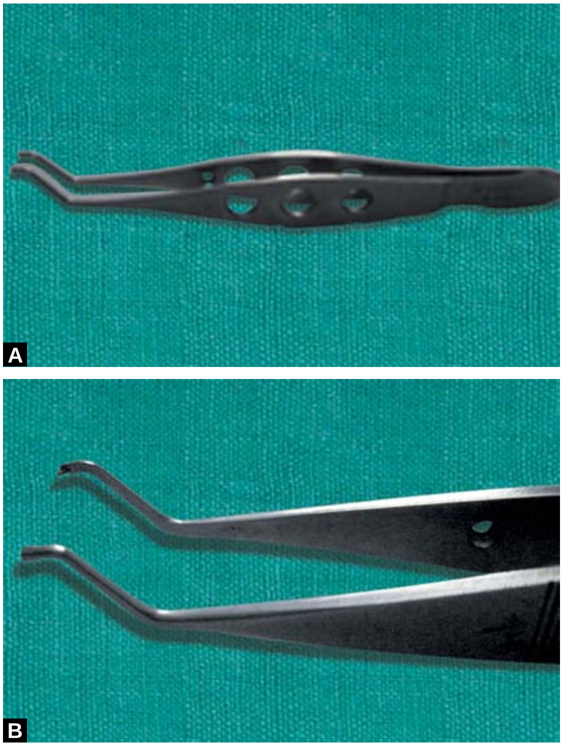
Superior rectus along with other recti muscles originate from common tendinous ring at the apex of the orbit and gets inserted into sclera at 7.7 mm from the limbus.

The distance of insertion of rectus muscles from limbus are:

Medial rectus	5.5 mm
Inferior rectus	6.5 mm
Lateral rectus	6.9 mm
Superior rectus	7.7 mm

Fixation Forceps

Fixation forceps **(Figs 6.7A and B)** have tooth at the tip and used to hold conjunctiva and episcleral tissues for fixing the globe during ocular surgeries.



Figs 6.6A and B: Superior rectus holding forceps

Corneoscleral Forceps

These are having fine teeth at the tip and are used to hold cornea and sclera for suturing during surgeries like ECCE, keratoplasty, trabeculectomy.

Pierse Type Microforceps

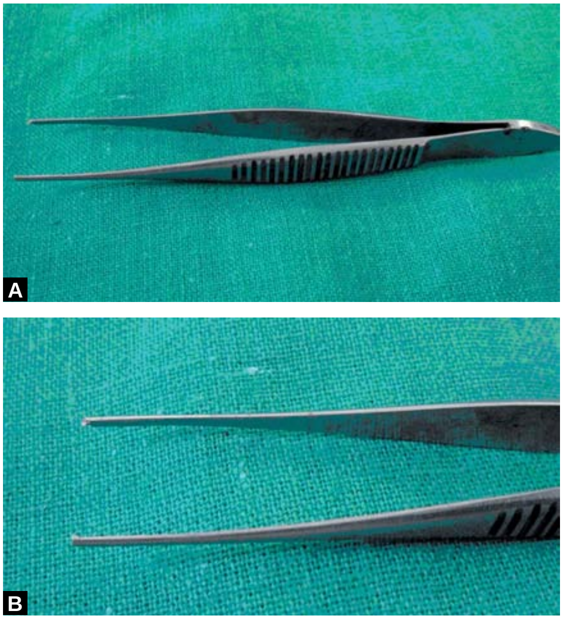
It is a straight forceps with fine teeth at the tip **(Fig. 6.8)**.

Lim's Forceps

It has a tying platform at the tip **(Figs 6.9A and B)**.

Tying Forceps

These are used for tying sutures (8-0 to 11-0) during surgeries like ECCE, keratoplasty,



Figs 6.7A and B: Fixation forceps

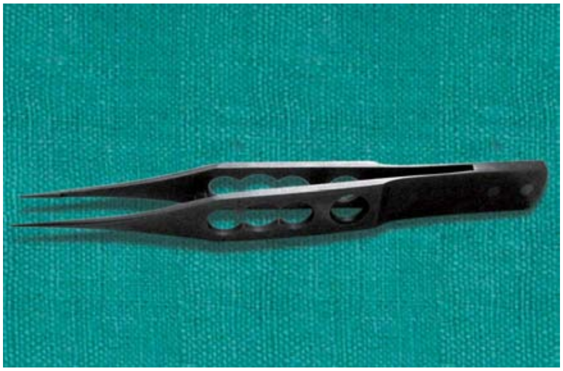


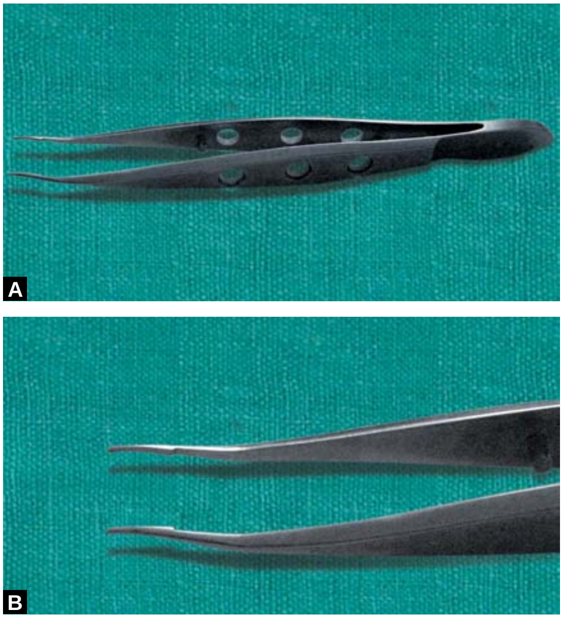
Fig 6.8: Pierse forceps

trabeculectomy, sclerocorneal tear reapir, conjunctival suturing during pterygium surgery.

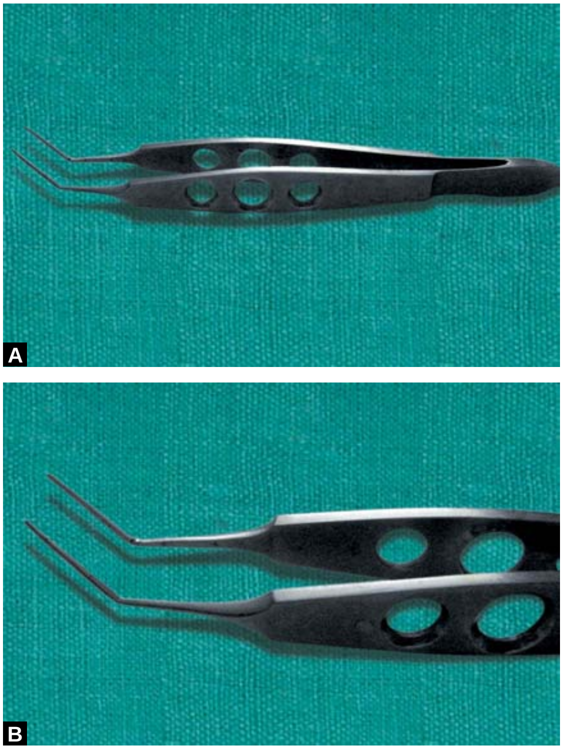
Kelman-McPherson Forceps (Figs 6.10A and B)

Other than for tying sutures it is also used to:

- Insert IOL **(Fig. 6.11)**
- To tear off the anterior capsular flap in ECCE.



Figs 6.9A and B: Lim's forceps



Figs 6.10A and B: Kelman-McPherson forceps

McPherson Tying Forceps

It is used only for tying sutures **(Figs 6.12A and B)**.

Jaffe Tying Forceps

It is used for tying sutures **(Figs 6.13A and B)**.

Iris Forceps

It is used to hold iris for doing iridectomy during surgeries like trabeculectomy **(Figs 6.14A and B)**.

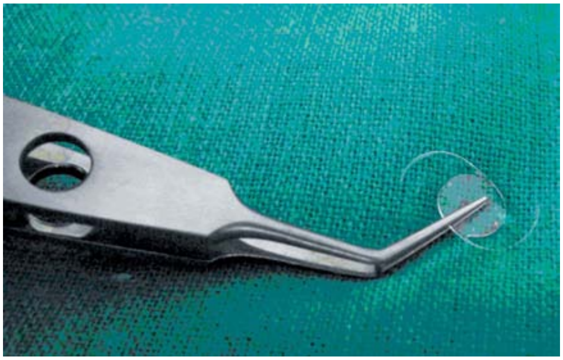
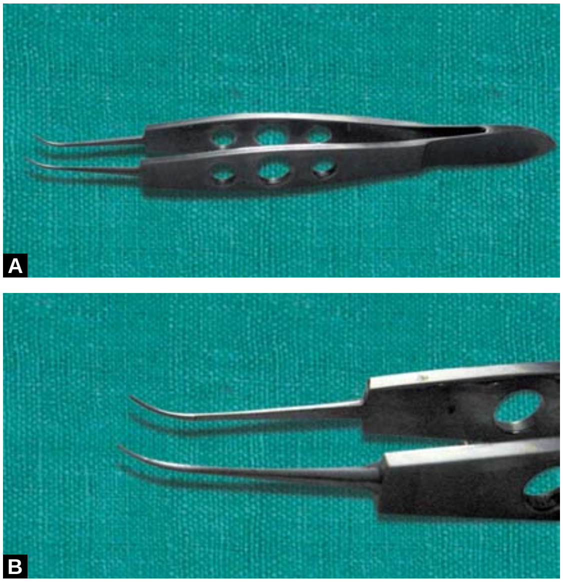


Fig. 6.11: Kelman-McPherson forceps with IOL

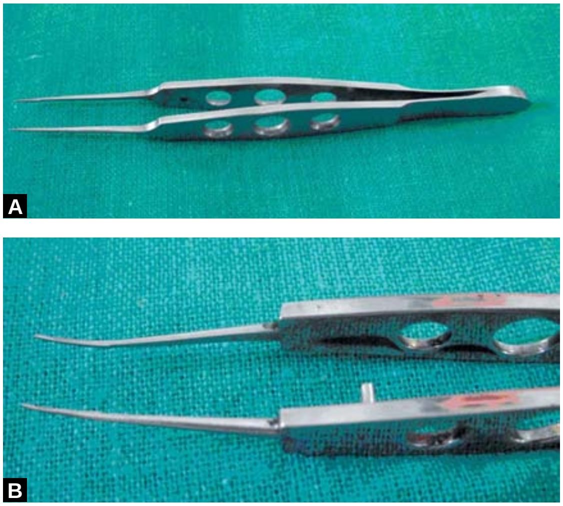


Figs 6.12A and B: McPherson tying forceps

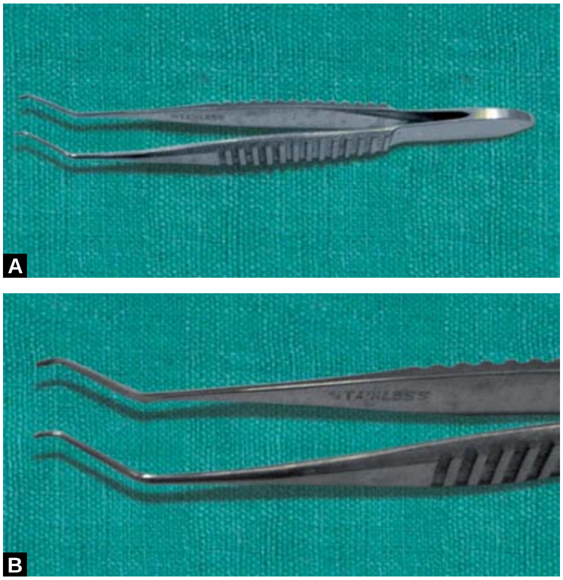
Artery Forceps

It is used for hemostatic purpose to catch the bleeding vessels to prevent bleeding during lid surgeries and lacrimal sac surgeries.

It is used to hold bridle suture for fixation of globe **(Figs 6.15 and 6.16)**.



Figs 6.13A and B: Jaffe tying forceps



Figs 6.14A and B: Iris forceps

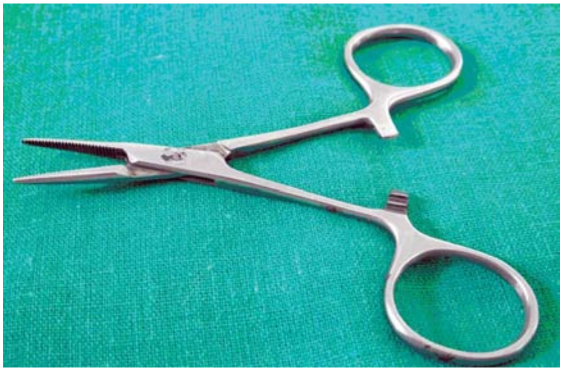


Fig. 6.15: Straight artery forceps

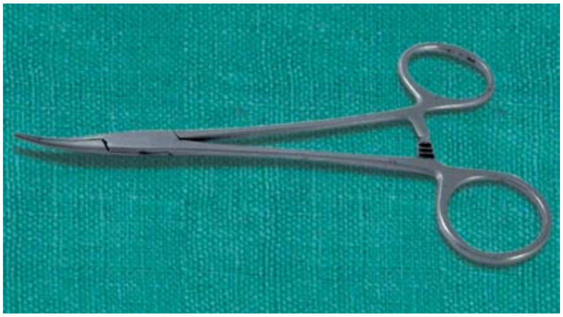


Fig. 6.16: Curved artery forceps

SCISSORS

These are instruments designed to cut tissues and sutures.

Conjunctival Scissors

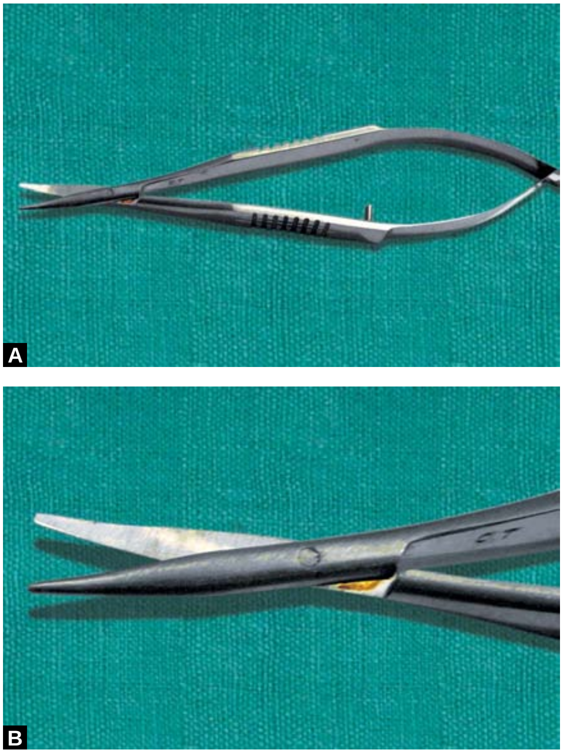
It is a fine curved scissor with blunt tip, the blades of the scissors are kept apart by spring action **(Figs 6.17A and B)**.

It is used to cut conjunctiva in various surgeries like pterygium excision, ECCE, SICS, trabeculectomy and squint surgeries.

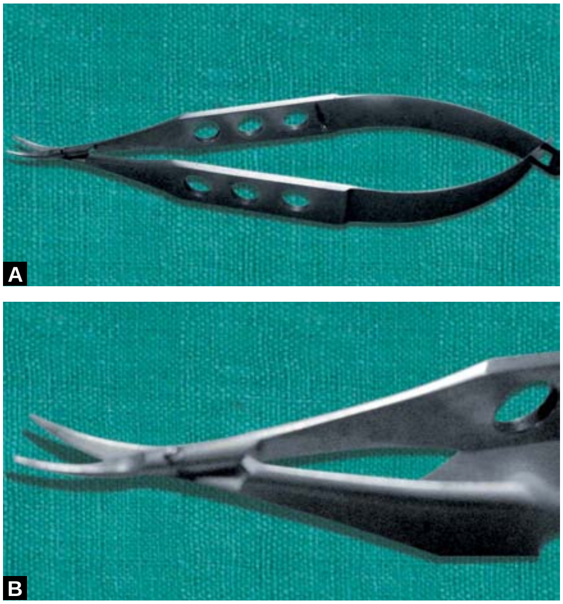
Corneal Scissors

It is a fine curved scissor with sharp tip, the blades of the scissors are kept apart by spring action **(Figs 6.18A and B)**.

It is used to cut cornea in surgeries like ECCE conventional, keratoplasty.



Figs 6.17A and B: Conjunctival scissors



Figs 6.18A and B: Corneal scissors

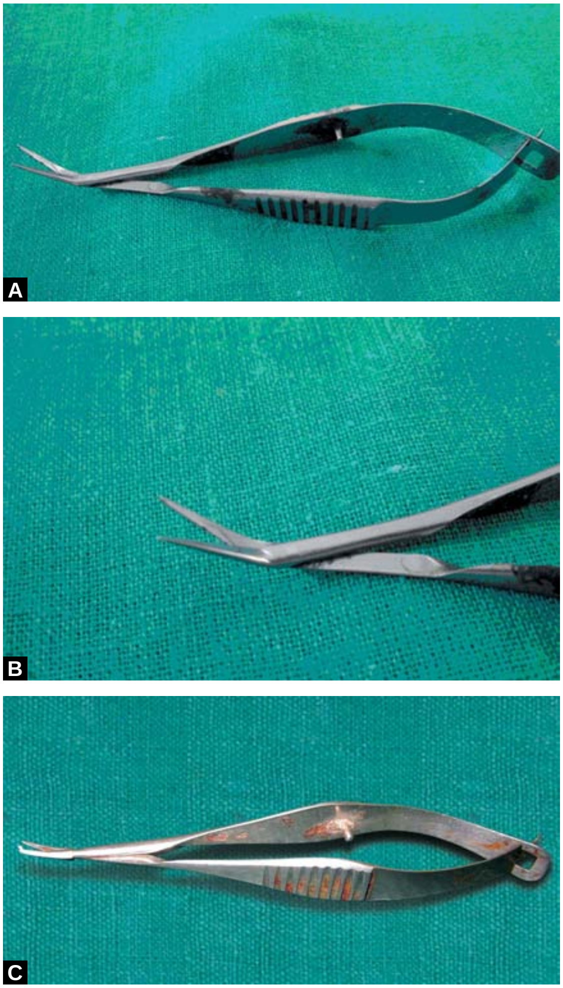
Vannas Scissors

It is a fine delicate scissor with small cutting blades **(Figs 6.19A to C)**.

In Vannas scissors blades can be straight or curved, respectively called as Vannas straight and curved scissors.

It is used to cut :

- Anterior capsule during ECCE
- To cut 10-0 and 9-0 nylon sutures
- To cut sphincter pupillae for sphincterotomy
- To cut iris for performing iridectomy.



Figs 6.19A to C: Vannas scissors

De Wecker Scissors

It is a fine scissor with small blades directed at right angles to the arms **(Fig. 6.20)**.

It is used to cut iris for performing iridectomy, to cut prolapsed vitreous during vitreous loss in surgeries like ICCE, ECCE with vitreous loss, SICS with vitreous loss.

Enucleation Scissors

It is a long curved scissors. It is used to cut optic nerve during enucleation **(Figs 6.21A and B)**.

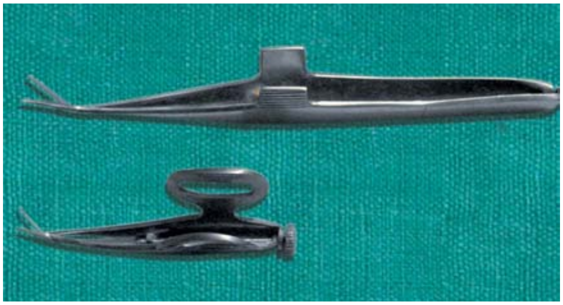
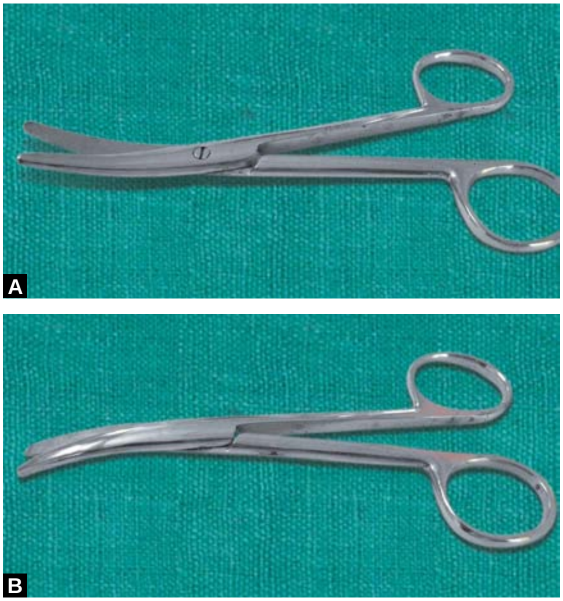


Fig. 6.20: De Wecker scissors



Figs 6.21A and B: Enucleation scissors

Plain Straight Scissors

It is used to cut skin sutures after lid surgeries, DCT, DCR **(Fig. 6.22)**.

KNIVES (BLADES)

Crescent Blade

It is sharp at the sides with blunt tip **(Figs 6.23A and B)**. It is used to do sclerocorneal tunnel in SICS (small incision cataract surgery).

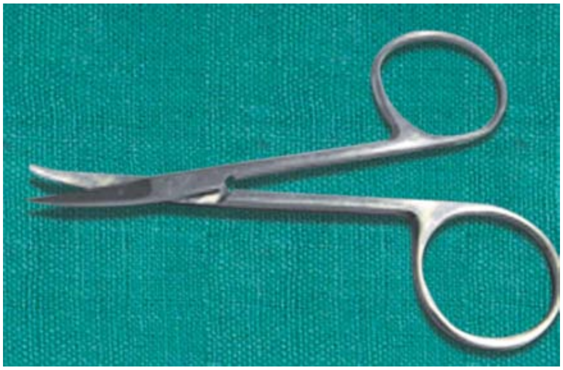
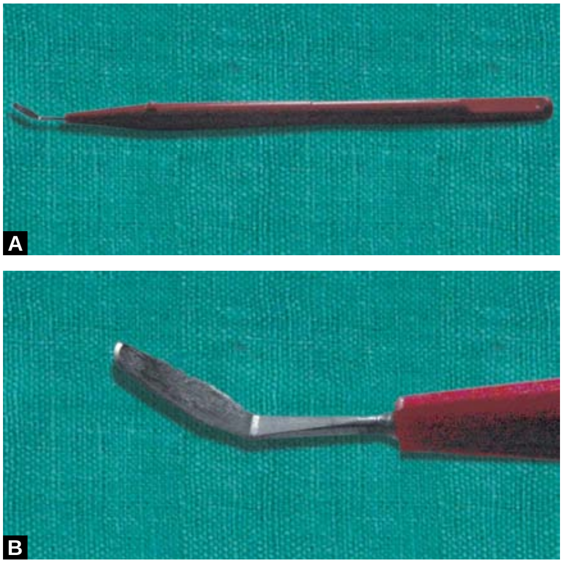


Fig. 6.22: Plain straight scissors



Figs 6.23A and B: Crescent blade

Keratome

It has a diamond shaped blade with two cutting edges and a sharp tip **(Figs 6.24A and B)**.

It is used to enter anterior chamber through sclerocorneal tunnel in SICS.

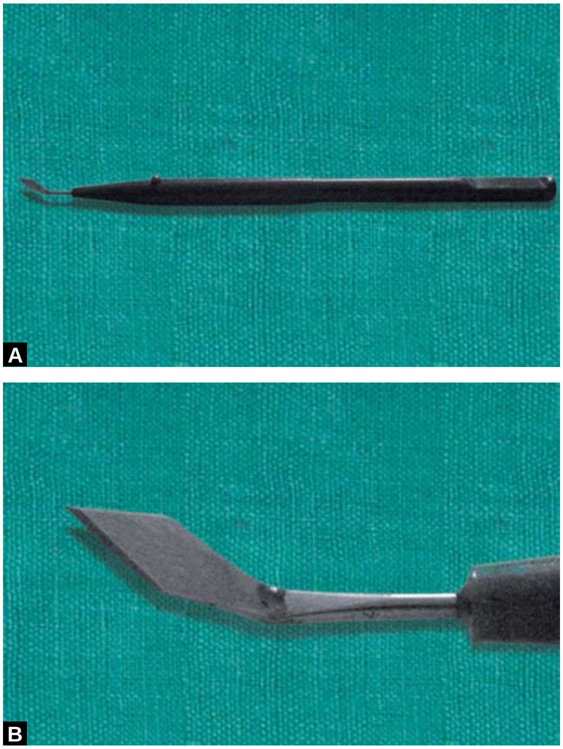
Paracentesis Needle (Side Port Blade)

It has a small sharp cutting blade **(Figs 6.25A and B)**.

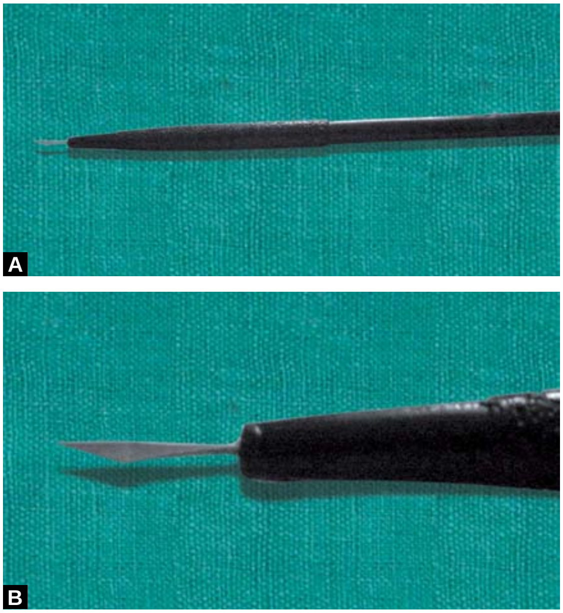
It is used to make paracentesis (side port) in SICS. Side port is used to make capsulotomy, cortical wash in SICS.

Extension Blade

It has cutting edges and a blunt tip. It is used to extend the corneoscleral section in small incision cataract surgery **(Figs 6.26A and B)**.



Figs 6.24A and B: Keratome



Figs 6.25A and B: Side port blade

Tooke's Knife

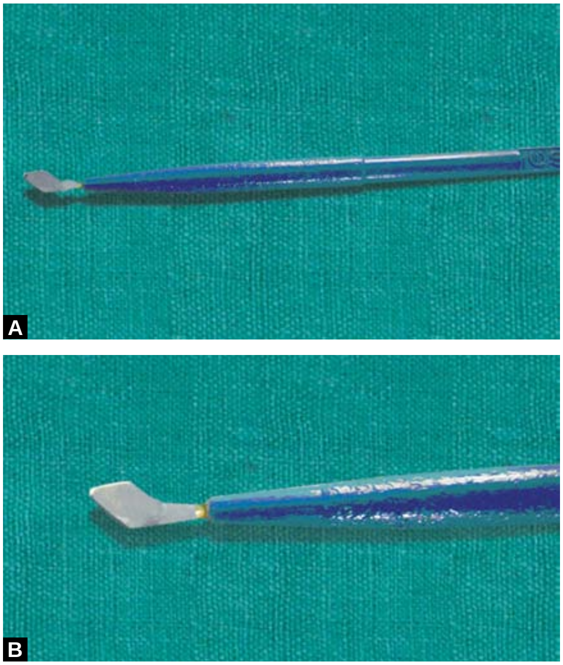
It has a flat blade with blunt edges **(Figs 6.27A and B)**. It is used to dissect corneal lamellae in lamellar keratoplasty, separate head of the pterygium from cornea, to separate tenons tissue from sclera in surgeries like SICS, ECCE, trabeculectomy.

Blade Braker and Holder

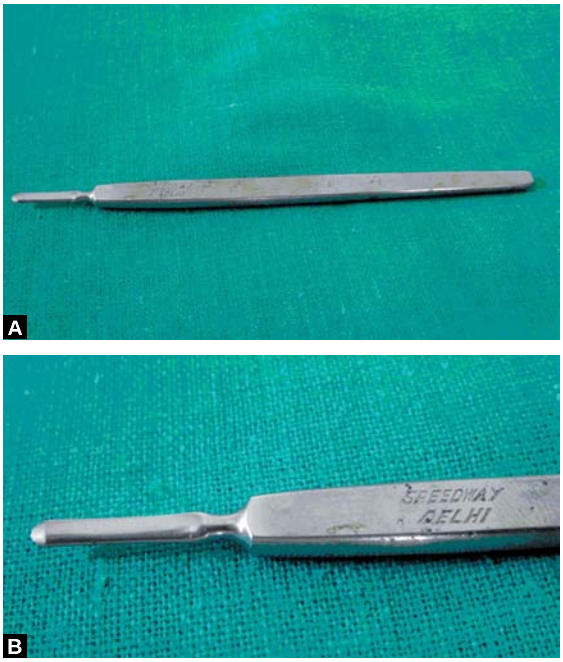
It has got jaws to hold the razor blade with a locking mechanism and is used to break razor blade which is used to make incisions in SICS, trabeculectomy **(Fig. 6.28)**.

Blade Holder

(Bard Parker blade holder) It is used to hold disposable surgical blades number 11 and 15 which are used to make incisions in surgeries like SICS, trabeculectomy **(Fig. 6.29)**.



Figs 6.26A and B: Extension blade



Figs 6.27A and B: Tooke's knife

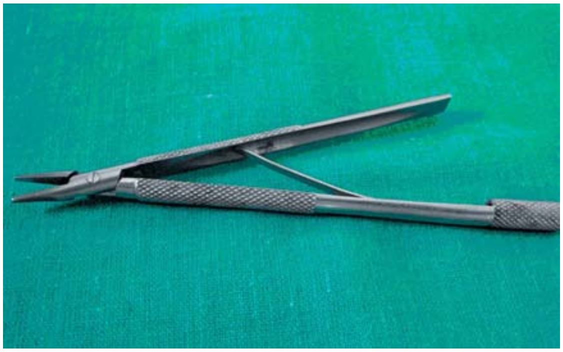


Fig. 6.28: Blade braker and holder

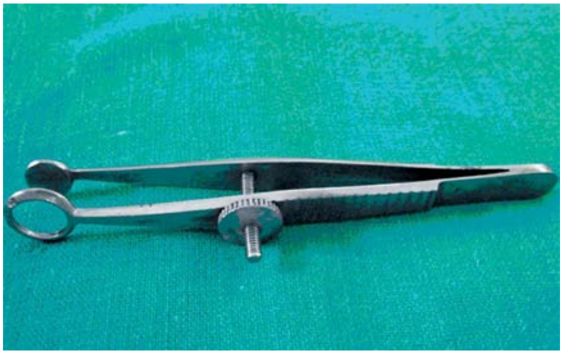


Fig. 6.30: Chalazion clamp

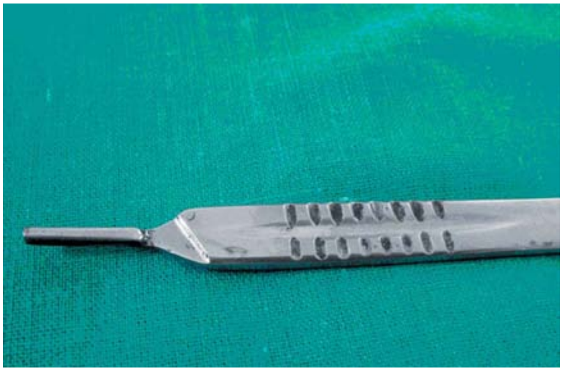


Fig. 6.29: Blade holder

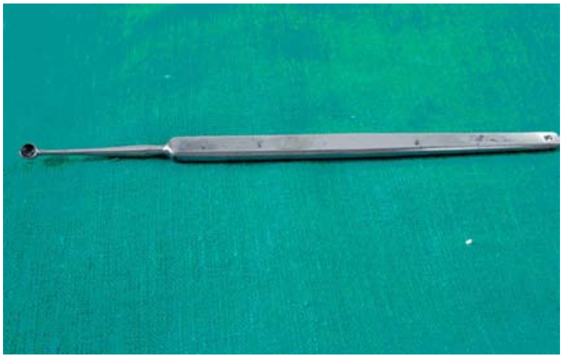


Fig. 6.31: Chalazion scoop

INSTRUMENTS FOR INCISION AND CURETTAGE OF CHALAZION

Chalazion Clamp

It has two circular blades one of which is open. It has a screw which can be tightened. It is used for incision and curettage of chalazion **(Fig. 6.30)**.

Solid blade is placed on the skin side and the open side is placed on the conjunctival side and the screw is tightened to hold the lid and to achieve hemostasis.

Chalazion Scoop

It has a round cupped tip used to curette the chalazion after incising it to scoop out the contents of the chalazion **(Fig. 6.31)**.

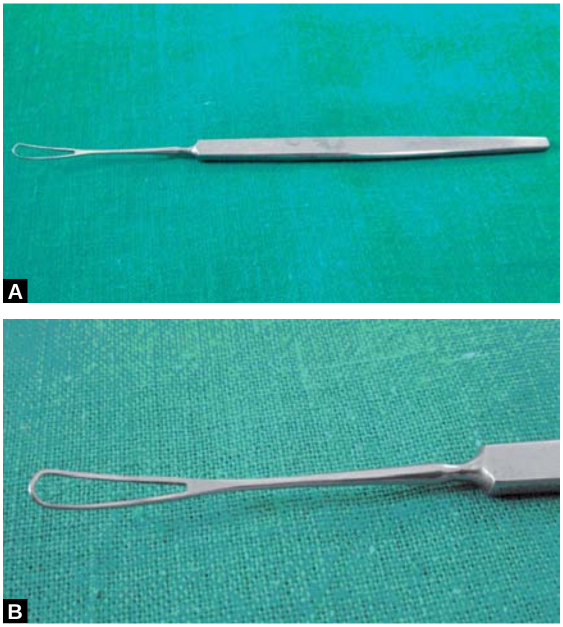
INSTRUMENTS FOR LENS REMOVAL

Wire Vectis

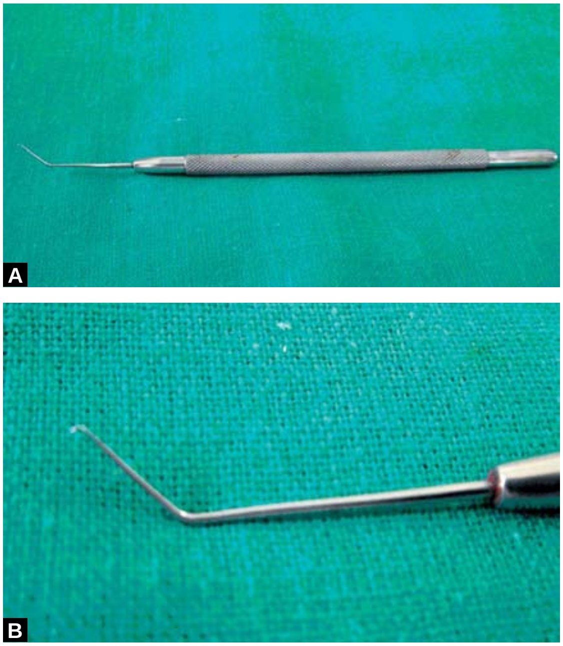
It has a wire loop at its end. It is used to remove nucleus out of the anterior chamber by phaco -sandwich method in SICS **(Figs 6.32A and B)**.

IOL Dialer

It has a long shaft at one end which progressively decreases in size towards the tip and is bent twice at right angles to each other **(Figs 6.33A and B)**. It is used to dial the posterior chamber IOL for proper positioning during IOL implantation in cataract surgery. It is used as an second instrument to hold the nucleus to remove it from anterior chamber in phaco-sandwich method in SICS. The other instrument used is wire vectis.



Figs 6.32A and B: Wire vectis



Figs 6.33A and B: IOL dialer

Irrigation Vectis

It has a wire loop at its end with irrigating ports **(Fig. 6.34)**. This is attached to infusion line for providing hydrostatic pressure to push the nucleus out of the anterior chamber in SICS.

INSTRUMENTS FOR IRRIGATION AND ASPIRATION OF CORTICAL MATTER DURING CATARACT SURGERY

Simcoe Bulb

It is a silicone bulb **(Fig. 6.35)**. This is filled with saline and is used to infuse saline during irrigation and aspiration.

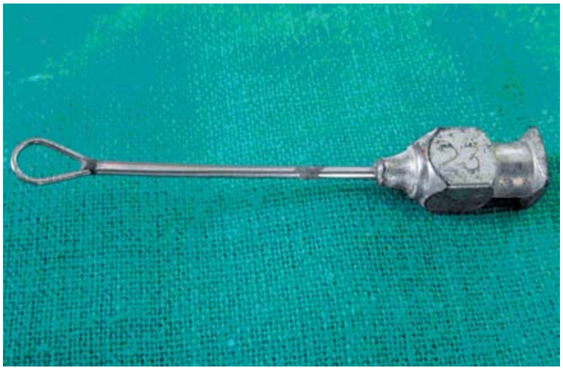


Fig. 6.34: Irrigation vectis

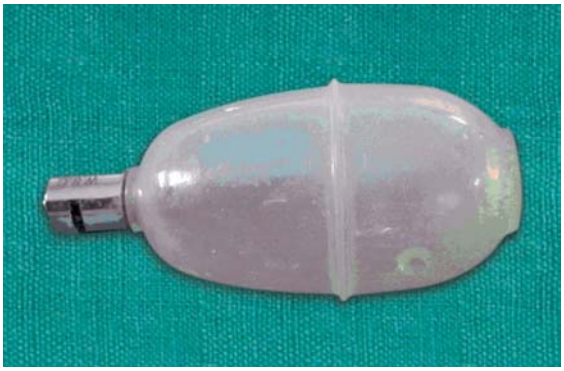


Fig. 6.35: Simcoe bulb

Two Way Irrigation and Aspiration Cannula

It is a cannula which has got two ports one for irrigation and another one for aspiration **(Figs 6.36A and B)**. Longer one, i.e. one at the tip is for aspiration which is attached to a syringe to get suction force and the shorter one, i.e. one at the side is for irrigation which is connected to symcoe bulb or infusion line. It is used for irrigation and aspiration of lens matter in ECCE.

INSTRUMENTS FOR ENUCLEATION

Optic Nerve Guide (Enucleation Spoon)

It has a spoon like end with a cleavage **(Fig. 6.37)**.

It is used in enucleation to cut the optic nerve. The cleavage is used to engage optic nerve and the surrounding spoon protects the globe.

Other instruments required for enucleation are: Lid speculum, fixation forceps, conjunctival scissors, muscle hook, artery forceps and enucleation scissors.

INSTRUMENTS FOR EVISCERATION

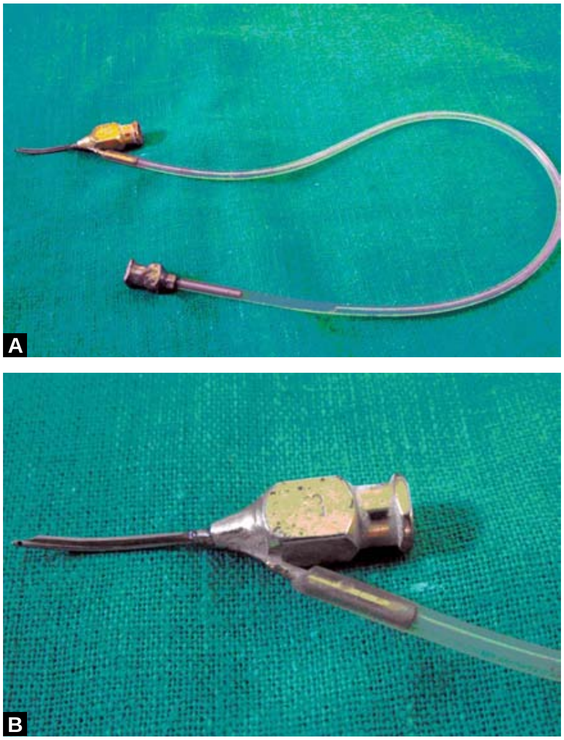
Evisceration Spatula

It is used to separate uveal tissue from sclera in evisceration **(Fig. 6.38)**.

Evisceration Curette

It has a rounded cupped tip (bigger than chalazion curette) used to curette the intraocular contents in evisceration **(Fig. 6.39)**.

Other instruments used for evisceration are: Lid speculum, fixation forceps, conjunctival scissors, razor blade with holder, needle holder.



Figs 6.36A and B: Two way or Bi-way irrigation and aspiration cannula

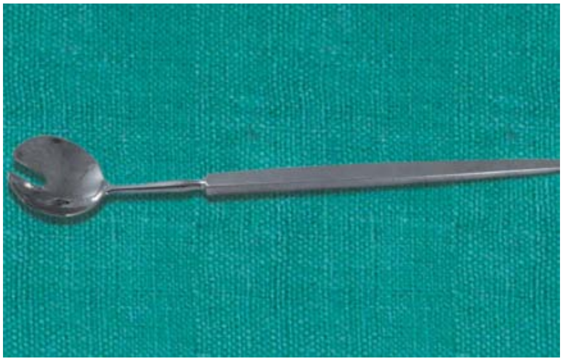


Fig. 6.37: Enucleation guide

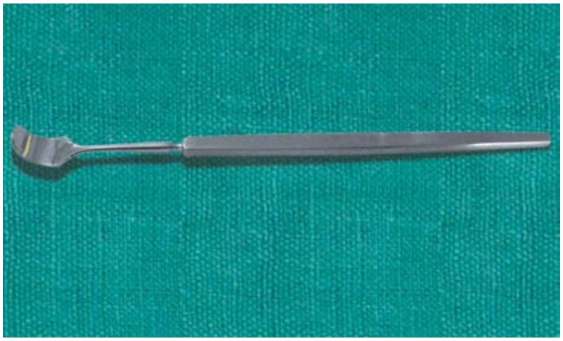


Fig. 6.38: Evisceration spatula

INSTRUMENTS FOR LACRIMAL SAC SURGERY

Nettleship's Punctum Dilator

It has a pointed tip and is used to dilate the puntum to accommodate lacrimal probe during probing and lacrimal cannula for performing lacrimal syringing **(Figs 6.40A and B)**.

Bowman's Lacrimal Probe

It resembles a metal wire with blunt rounded ends **(Figs 6.41A and B)**.

It is used to probe nasolacrimal duct in probing for congenital dacryocystitis and to identify lacrimal sac in surgeries of lacrimal sac like DCT and DCR. Lacrimal probes are available in four different sizes.

Bone Punch

It is used to cut lacrimal bone in DCR surgery to create an ostium between lacrimal sac and middle meatus **(Fig. 6.42)**.

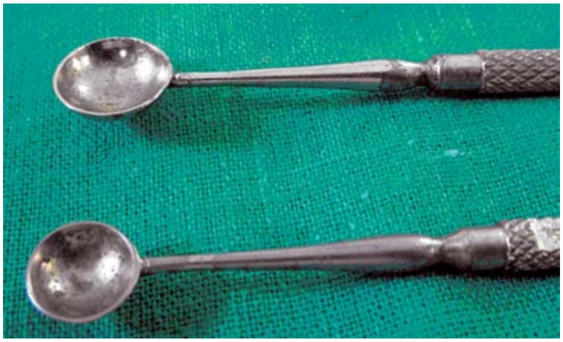
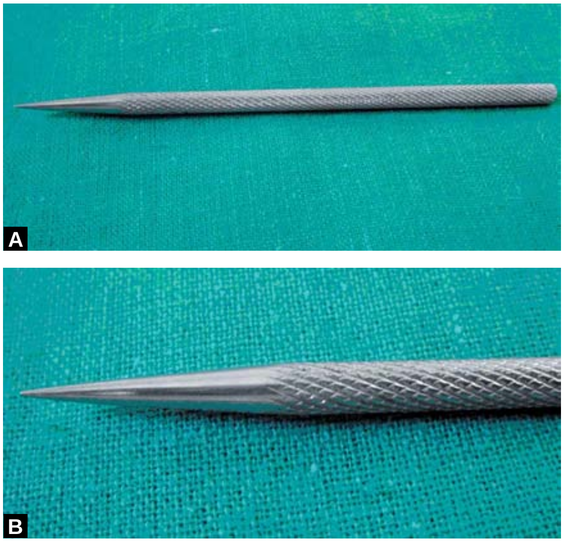
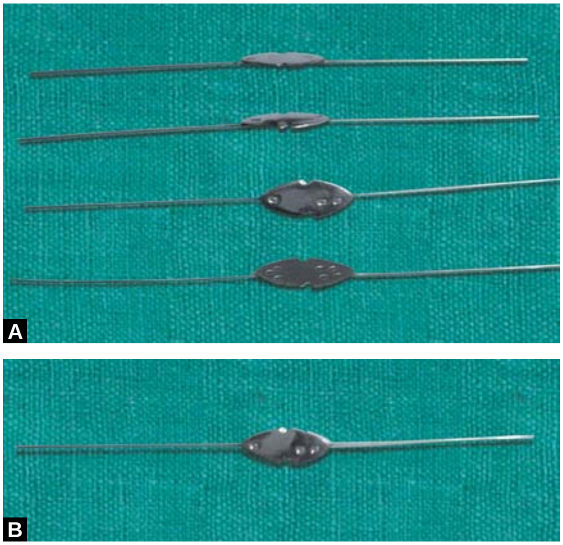


Fig. 6.39: Evisceration curette



Figs 6.40A and B: Nettleship's punctum dilator



Figs 6.41A and B: Bowman's lacrimal probe

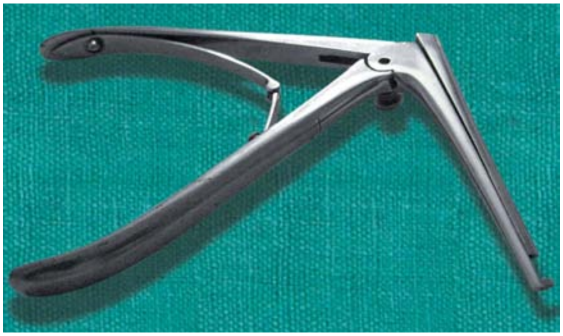


Fig. 6.42: Bone punch

Lacrimal Sac Dissector and Curette

It is a blunt tipped instrument. It is used to dissect and separate lacrimal sac from surrounding structures in DCT and DCR.

HOOKS AND RETRACTORS

Muscle Hook

It resembles a hook with a blunt knob **(Figs 6.43A and B)**. It is used to hook extraocular muscles during squint surgeries and enucleation.

Desmarres Lid Retractor

It is a spatulated instrument with the tip having a smooth fold which is folded inwards **(Figs 6.44A and B)**.

Uses

- For double eversion of the upper eyelid for examination of superior conjunctival fornix
- To retract the eyelids for ocular examination in children, in adults with ecchymosis of eyelids

Cat's Paw (Lacrimal Wound Retractor)

It resembles cat's paw with the tip bent inwards **(Figs 6.45A and B)**.

Uses

To retract the skin during lacrimal sac surgeries like DCT and DCR.

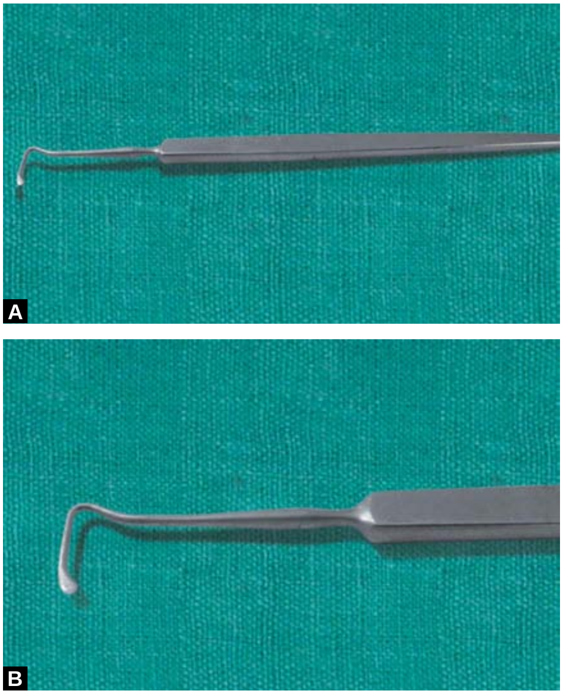
CASTROVIEJO CALIPERS

It resembles like compass with a graduated scale at one end **(Fig. 6.46)**.

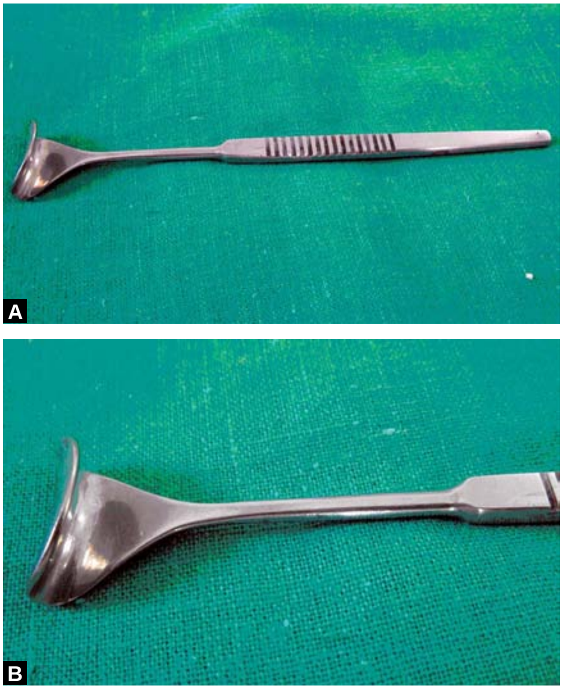
Uses

For taking measurements like:

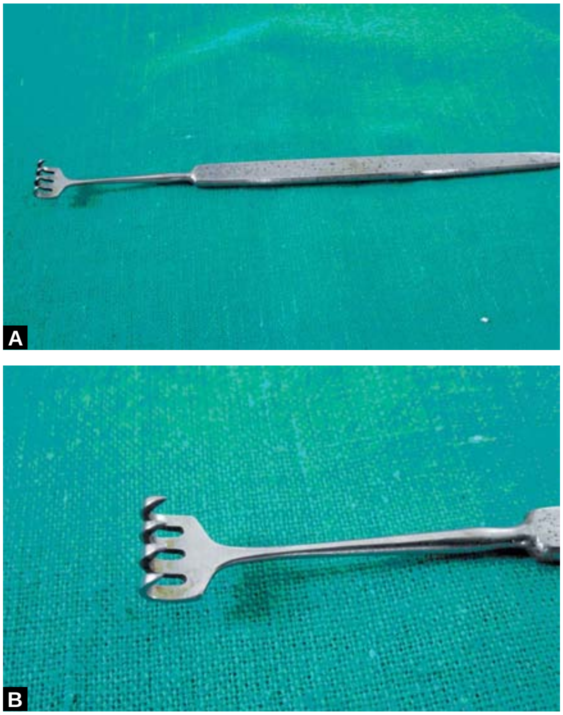
- Measurement of corneal size
- Measurements during squint surgery to calculate the amount of recession and resection



Figs 6.43A and B: Muscle hook



Figs 6.44A and B: Desmarres lid retractor



Figs 6.45A and B: Cat's paw

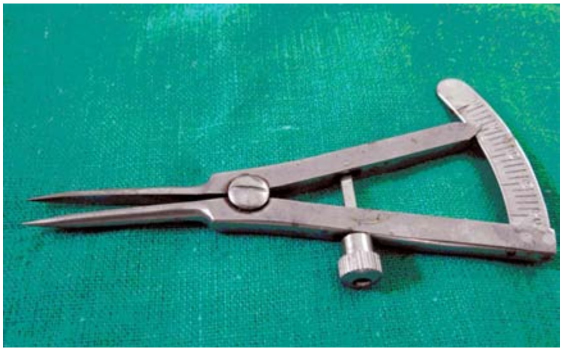


Fig. 6.46: Castroviejo calipers

- Measurements to locate pars plana during pars plana surgeries, intravitreal injection.

> The posterior smooth part of the ciliary body is called pars plana. It is 5 mm wide temporally and 3 mm wide nasally.

IRIS REPOSITOR

It is a blunt tipped instrument **(Fig. 6.47)**.

Uses

To reposit the iris into anterior chamber if it prolapses out during surgeries like cataract surgery, keratoplasty, corneal tear repair.

THERMAL BALL POINT CAUTERY

The instrument consists of a copper ball and a tip with a long handle.The instrument is heated with the copper ball held in the flame of spirit lamp and the heat which is retained by the

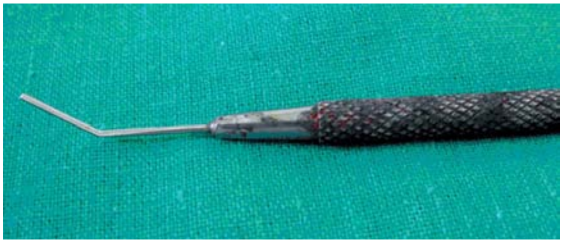


Fig. 6.47: Iris repositor

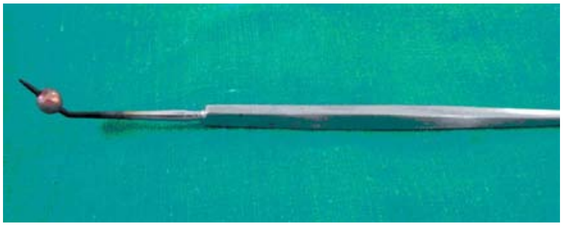


Fig. 6.48: Thermal ball point cautery

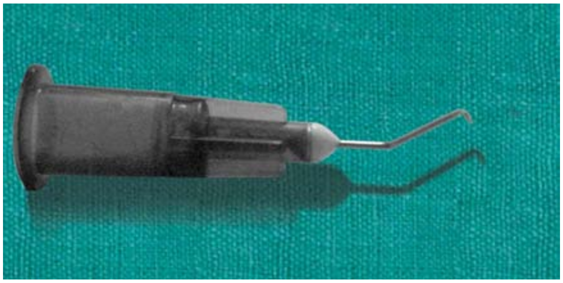


Fig. 6.49: Cystitome

copper ball is transmitted to the tip that is used to achieve hemostasis by thermal coagulation **(Fig. 6.48)**. (to cauterize conjunctival and episcleral vessels).

Uses

To cauterize bleeding vessels in surgeries involving conjunctival periotomy like cataract surgery, ptergium excision, trabeculectomy.

CYSTITOME OR CAPSULOTOME

Twenty six guage needle is bent twice, once at the tip and one more bent perpendicular to first one **(Fig. 6.49)**.

Uses

For doing capsulotomy/capsulorrhexis during ECCE.

CHAPTER

7

OPHTHALMIC LENSES

CHAPTER OUTLINE

- Lens
- Pinhole
- Stenopaic Slit
- Jackson's Cross Cylinder
- Maddox Rod
- 20D Lens
- +78D Lens

LENS

A transparent refractive medium with two surfaces which form a part of a sphere or a cylinder is called Lens.

Types

Spherical Lenses

Spherical lenses are bounded by two surfaces which form a part of a sphere. Spherical lens can be:

- Convex spherical lens (plus lens)
- Concave spherical lens (minus lens).

Cylindrical Lenses

Cylindrical lenses are bounded by two surfaces which form a part of cylinder. Cylindrical lenses can be:

- Convex cylindrical lens
- Concave cylindrical lens.

Lens

The following questions have to be answered:
How to identify the type of lens?
What are the uses of the lens?

How to identify the type of lens?

Those with handle are spherical lenses and those without handle and with a line marked on the frame holding the lens are cylindrical lenses (in cylindrical lenses handle is absent to facilitate smooth rotatory movement to check the axis of the cylinder and line marked on it to identify the axis of the cylinder. But do not identify lens by this method what is expected is to see.

What is happening to the object when seen through the lens?

Magnification: Convex lens

Minification: Concave lens

Movement of the object when lens is moved

Object moves in both the axis—Sphere

Object moves in only one axis—Cylinder

Object moves in opposite direction as the lens—Convex lens

Object moves in same direction as the lens—Concave lens

Distortion of the image when the lens is rotated-Cylinder.

Spherical lens: Object seen through it moves in both axis and there is no distortion of object on rotating the lens.

Cylindrical lens: Object seen through it moves in one axis (direction right angle to the axis) (line marked on a cylindrical lens indicates the principal axis, i.e. along which the lens does not have any power, i.e. no action along this axis) and there is distortion of object on rotating the lens.

Lens 1

Object when seen through the lens appears magnified.

Object moves in both the axis and in opposite direction as the lens when the lens is moved.

No distortion of the image when the lens is rotated.

Lens is thicker in the center and thin at the periphery.

Hence, the lens is convex spherical.

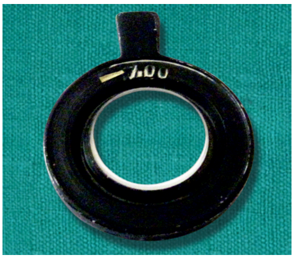


Fig. 7.1: Spherical lens

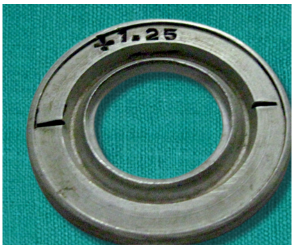


Fig. 7.2: Cylindrical lens

Uses

- For correction of hypermetropia, presbyopia, aphakia
- 20D lens in indirect ophthalmoscopy
- +78D, +90D lens for slit lamp biomicroscopic examination of the fundus
- In Loupe and lens examination-focal illumination for examination of structures of anterior segment of eye **(Fig. 7.3)**.

Lens 2

Object when seen through the lens appears minified.
Object moves in both the axis and in same direction as the lens when the lens is moved.
No distortion of the image when the lens is rotated.
Lens is thin in the center and thick at the periphery.
Hence, the lens is concave spherical.

Uses

- For correction of myopia
- Hruby lens -58.6D lens for slit lamp biomicroscopic examination of the fundus **(Fig. 7.4)**.

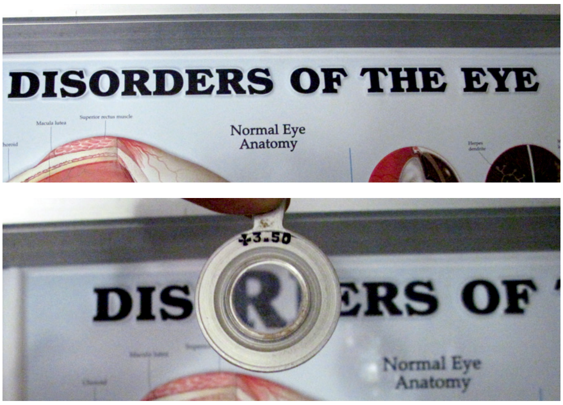


Fig. 7.3: Magnification of image through spherical convex lens

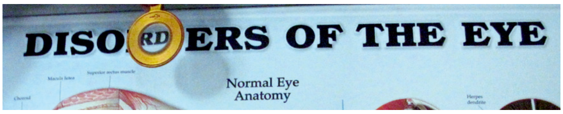


Fig. 7.4: Minification of image through spherical concave lens

Lens 3

Object when seen through the lens appears magnified.
Object moves in one axis and in opposite direction as the lens when the lens is moved.
Distortion of the image when the lens is rotated.
Lens is thicker in the center and thin at the periphery.
Hence, the lens is convex cylinder.

Uses

- For correction of hypermetropic astigmatism
- In Jackson's cross cylinder for verification of subjective refraction **(Fig. 7.5)**.

Lens 4

Object when seen through the lens appears minified.
Object moves in one axis and in same direction as the lens when the lens is moved.
Distortion of the image when the lens is rotated.
Lens is thin in the center and thick at the periphery.
Hence, the lens is concave cylinder.

Uses

- For correction of myopic astigmatism
- In Jackson's cross cylinder for verification of subjective refraction **(Fig. 7.6)**.

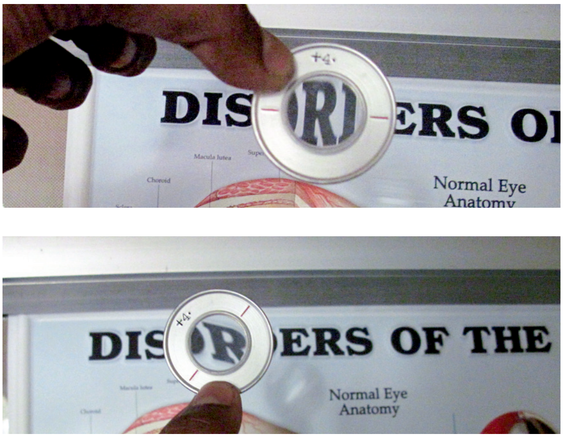


Fig. 7.5: Magnification of image through convex cylindrical lens and distortion of image on rotating the lens through convex cylindrical lens

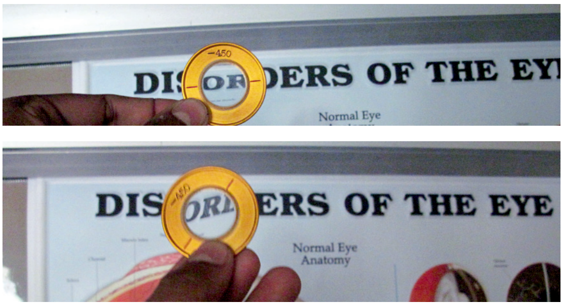


Fig. 7.6: Minification of image through concave cylindrical lens and distortion of image on rotating the lens through concave cylindrical lens

PINHOLE

It is used for pinhole test.

Pinhole Test

If the distance vision is less than 6/6, all patients should be asked to look through a pinhole and improvement if any in visual acuity should be recorded.

A pinhole cuts off all the peripheral rays and allows only central parallel beam of rays to enter eye and visual improvement is seen in cases of refractive errors.

If the cause for diminution of vision is not refractive error like cataract or retinal diseases then improvement is not seen.

The size of the pinhole is 1 mm **(Fig. 7.7)**.

STENOPAIC SLIT

It is used for stenopaic slit test.

Stenopaic Slit Test

Stenopaic slit allows clearest vision when it is rotated into the axis of astigmatism. It is done for checking the correction of astigmatism. If the vision improves with stenopaic slit when it is rotated into the axis of astigmatism it indicates under correction.

The size of the slit is 1 mm **(Fig. 7.8)**.

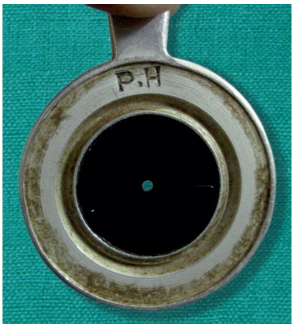


Fig. 7.7: Pinhole

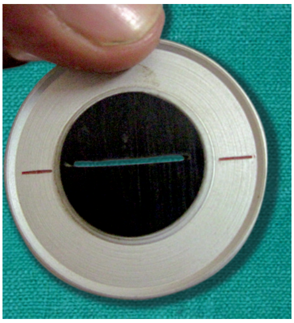


Fig. 7.8: Stenopaic slit

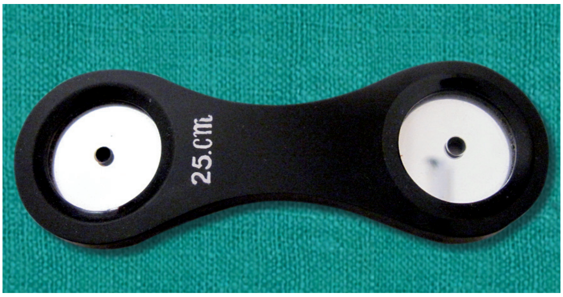


Fig. 7.9: Mirror retinoscope

Priestley Smith Retinoscopic Mirror

It is a combination of plane mirror and concave mirror. It is used for doing retinoscopy.

Plane mirror is used in all patients for retinoscopy and in patients with hazy media concave mirror is preferred (as concave mirror converges the light rays).

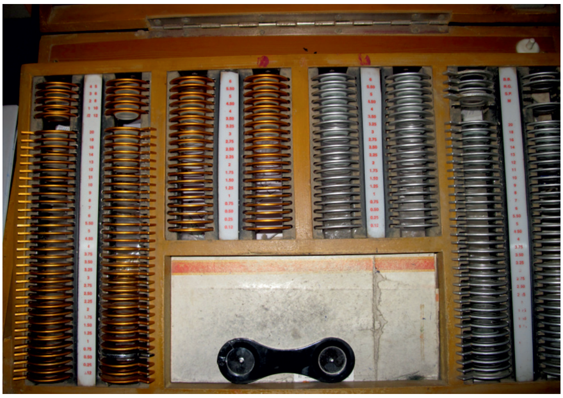


Fig. 7.10: Trial lens set

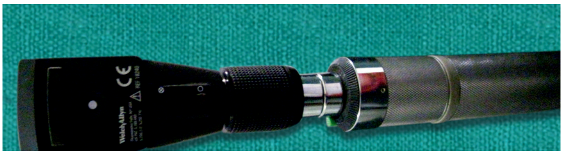


Fig. 7.11: Streak retinoscope

JACKSON'S CROSS CYLINDER

It is combination of two cylinders of equal strength with opposite signs with their axis at right angles to each other. Commonly used powers are +/-0.25D and +/-0.5D.

It is used for verification of cylinder power and axis **(Fig. 7.12)**.

MADDOX ROD

It consists of plus cylinders arranged parallaly which convert point light into a straight line of light at right angle to the axis of the rod.

Maddox Rod Test for Assessing Macular Function

Patient is asked to look through a Maddox rod at a bright light if the patient sees continuous unbroken and undistorted red line then the macula is normal, if the line is broken it shows some pathology of macula.

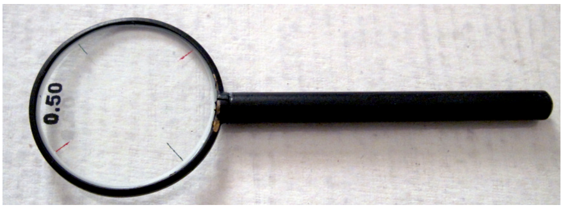


Fig. 7.12: Jackson's cross cylinder

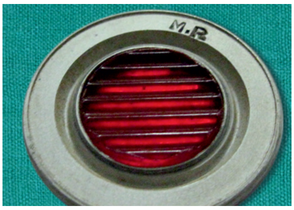


Fig. 7.13: Maddox rod

Maddox Rod Test for Measurement of Latent Squint

It works by presenting dissimilar images to two eyes there by breaking fusion and measures phoria (latent squint).

It is done from a distance of 6 m hence it measures phoria for distance.

Maddox rod is placed infront of the right eye and asked to see point source of light. This dissociates the two eyes as he will be seeing red line in right eye and a point source of light in left eye.The number on Maddox tangent scale where the red line falls gives the amount of heterophoria in degrees.

Double Maddox Rod Test

It is done to diagnose torsional squint (cyclotropia). Two Maddox rods are placed one each front of each eye with the axis horizontally so that the patient sees vertical lines. Patient without cyclotropia see the lines parallel to each other, with incyclotropia the twelve o·clock position of the line is seen turned nasally and in excyclotropia it is seen turned temporally.

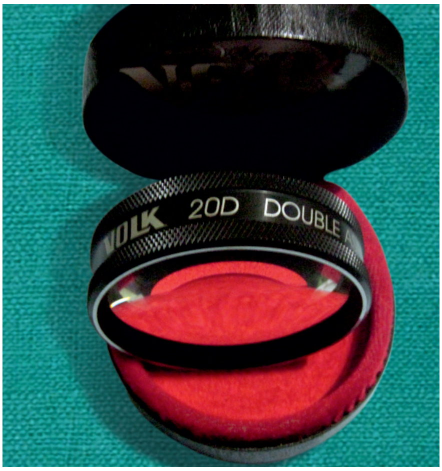


Fig. 7.14: 20D lens

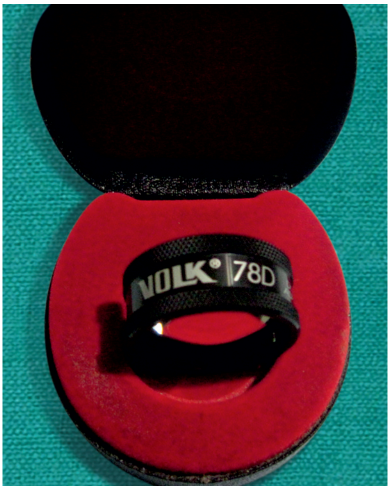


Fig. 7.15: 78D lens

20D LENS

It is used for indirect ophthalmoscopy for examination of fundus. It provides magnification of 3 times **(Fig. 7.14)**.

+78D LENS

It is used for slit lamp biomicroscopic examination of retina. Other lenses used for slit lamp biomicroscopic examination of retina are +90D lens and -58.6D lens **(Fig. 7.15).**

CHAPTER

8

DRUGS USED IN OPHTHALMOLOGY

CHAPTER OUTLINE

- Antiglaucoma Drugs
- Mydriatics and Cycloplegics
- Corticosteroids
- Antibacterial Drugs
- Antiviral Drugs
- Antifungal Drugs
- Nonsteroidal Anti-Inflammatory Drugs
- Local Anesthetic Drugs
- Injection Hyaluronidase
- Viscoelastics
- Artificial Tears
- Sutures
- Dyes

ANTIGLAUCOMA DRUGS

The main objective of drug treatment in glaucoma is to reduce intraocular pressure so that optic nerve damage and visual field defects are prevented.

Antiglaucoma drugs are classified as:

Adrenergic Agonists (Sympathomimetics)

Nonselective alpha adrenergic agonists:

Epinephrine

Selective alpha adrenergic agonists:

- Apraclonidine
- Brimonidine.

Adrenergic Antagonists

Nonselective beta blocker:

- Timolol
- Levobunolol.

Selective beta-1 blocker:

Betaxolol

Parasympathomimetic Drugs

- Pilocarpine
- Carbachol.

Hyperosmotic Agents

- Oral glycerine
- Intravenous mannitol and urea.

Prostaglandins

- Latanoprost
- Bimatoprost
- Travoprost
- Unoprostone.

Carbonic Anhydrase Inhibitors

- Oral acetazolamide
- Topical dorzolamide.

Neuroprotective Agents

- Calcium channel blockers
- Antioxidants
- Vasodilators.

Pilocarpine: One percent, two percent, four percent four times per day.

Pilocarpine is a natural alkaloid obtained from pilocarpus microphyllus.

Mechanism of Action

Increased outflow through trabecular meshwork by contraction of longitudinal fibers of the ciliary muscles leading to opening of trabecular pores in open angle glaucoma.

Peripheral iris is pulled away from trabecular meshwork by constriction of pupil thereby preventing the crowding of iris at the angle of anterior chamber in narrow angle glaucoma.

Indications

- Primary open angle glaucoma
- Angle closure glaucoma
- Noninflammatory secondary glaucoma
- Intraoperatively to achieve misosis of pupil

> Pilocarpine was the first-line of drug till 1980s now it is replaced by beta blockers and prostaglandin analogs.

Contraindications

Inflammatory glaucomas.

Adverse Side Effects

Ocular

- Myopia due to ciliary muscle contraction
- Retinal hole formation
- Retinal detachment
- Iris cysts
- Ocular pemphigoid.

> Pilocarpine has to be avoided in patients with risk factors for retinal detachment like high myopics, patients with retinal holes.

Systemic

Increased systemic muscarinic activity due to systemic absorption across the nasolacrimal duct causing lacrimation, salivation, diarrhea, vomiting, bronchospasm.

Timolol: 0.25 percent, 0.5 percent two times per day.

Mechanism of Action

It is a nonspecific beta-1 and beta-2 blocker, thus causing decrease in production of aqueous humor.

Indications

Timolol is the most common drug used to lower intraocular pressure in all kinds of glaucomas.

All varieties of glaucoma open angle, narrow angle, secondary glaucomas….

Contraindications

Asthma, chronic obstructive pulmonary disease, bradycardia, congestive heart failure.

Adverse Effects

Ocular: Allergic conjunctivitis, keratoconjunctivitis sicca, corneal anesthesia, superficial punctate keratitis.

Systemic: Bronchospasm, bradycardia, CNS side effects like depression, anxiety, disorientation.

Timolol has to be used with caution in diabetics as it masks the signs of hypoglycemia.

Betaxolol: 0.25 percent, 0.5 percent two times per day.
It is similar to timolol in its mechanism of action and its uses, except that it selectively blocks beta-1 receptors. It is less effective in reducing IOP as the ciliary body adrenoreceptors are predominantly beta-2.
Since, it selectively blocks beta-1 receptors it can be safely used in patients with asthma, chronic obstructive pulmonary disease where timolol is contraindicated, however cardiac side effects are more with betaxolol.

Brimonidine an selective alpha 2 adrenergic agonist acts by decreasing aqueous production. It’s efficacy is similar to timolol.

Hyperosmotic Agents

Mechanism of Action

They act by increasing the osmolarity of plasma leading to absorption of water from ocular tissues thus decreasing the IOP.

Indications

Acute glaucomas where IOP is very high and need to be reduced immediately.

Oral glycerol 1.5–3 ml per kg body weight and intravenous mannitol 1–2 gm per kg body weight are the commonly used hyperosmotic agents.

Prostaglandins

Mechanism of Action

Increased uveoscleral outflow by altering the extracellular matrix of ciliary muscle (increase in spaces and decrease in the resistance to outflow).

Latanoprost 0.005 percent one drop once daily is the most commonly used prostaglandin.

Latanoprost has got more efficacy than timolol and is among the first line drugs for glaucoma.
Latanoprost should be stored below room temperature and in darkness as it has thermal and solar instability.

Adverse effects

Brownish discoloration of iris—iris suntan syndrome
Conjunctival hyperemia
Cystoid macular edema
Trichomegaly, i.e. increase in the length of eye lashes.

Carbonic Anhydrase Inhibitors

Mechanism of Action

Inhibition of carbonic anhydrase present in the epithelium of ciliary body thus preventing bicarbonate anions and sodium influx there by decreasing aqueous production.

Oral acetazolamide 250 mg four times per day is the recommended dosage.

Adverse Effects

Metallic taste to food, depression, kidney stones, metabolic acidosis, hypokalemia, bone marrow depression.

MYDRIATICS AND CYCLOPLEGICS

They are anticholinergic drugs which cause dilatation of pupil and paralyze the action of ciliary muscle.

Tropicamide

It is the shortest acting mydriatic. It does not have cycloplegic action. Its action lasts for 4–6 hours. It is available as 0.5 percent eyedrops and used for dilatation of pupil before indirect ophthalmoscopy, before cataract surgery, for retinoscopy in patients with hazy media aged more than 18 years.

Cyclopentolate

It is both mydriatic and cycloplegic and its action lasts for 24 hours. It is used for retinoscopy in children aged between 7–18 years, in treatment of iridocyclitis, corneal ulcer.

Homatropine

It causes both mydriasis and cycloplegia and its action lasts for 72 hours. It is used for retinoscopy in children aged between 7–12 years, in treatment of iridocyclitis, corneal ulcer.

Atropine

It is the strongest and longest acting mydriatic and cycloplegic agent. It is available as 1 percent eye ointment and eye drops. Its action lasts for 21 days. It is used in retinoscopy in children less than 7 years, treatment of iridocyclitis, corneal ulcer.

Role of atropine and other cycloplegics in treatment of iridocyclitis and corneal ulcer

Atropine relieves ciliary spasm by causing paralysis of ciliary muscle action. It increases blood supply by relieving pressure on ciliary arteries, decreases exudation by decreasing vascular permeability and prevents the formation of synechiae.

Atropine eye drops have to be avoided because of risk of systemic toxicity by absorption via nasolacrimal duct

Side effects and toxicity of atropine

Dry mouth, difficulty in talking, dry flushed hot skin, difficulty in micturation, dilated pupil, delirium, rapid cardiovascular collapse, convulsions.

Atropine and other cycloplegics are contraindicated in narrow anterior chamber angle as they may precipitate angle closure glaucoma.

CORTICOSTEROIDS

Corticosteroids have potent anti-inflammatory and antiallergic action.

Commonly used corticosteroids are:

- Hydrocortisone (short acting less than 12 hours)
- Prednisolone and methyl prednisolone (intermediate acting 12–36 hours)
- Dexamethasone and Betamethasone (long acting > 36 hours).

Indications

Topical steroids are used in:
Allergic conjunctivitis, scleritis, episcleritis, Mooren's ulcer, iridocyclitis, postoperative period after cataract surgery, pterygium surgery, keratoplasty.

Systemic steroids are used in:
Optic neuritis, traumatic optic neuropathy, posterior uveitis, pseudo tumor of orbit, thyroid ophthalmopathy, sympathetic ophthalmitis.

Adverse Effects

Ocular: Glaucoma, delayed wound healing, cataract, activation of infection.

Systemic: Gastric ulcer, osteoporosis, cushingoid status, aggravation of diabetes mellitus, psychiatric disturbances (mild euphoria is the most common), susceptibility to infection.

Steroids are contraindicated in all infective conditions caused by bacteria, viruses and fungi.

Topical steroids when used for longer duration are known to cause glaucoma because of deposition of mucopolysaccharides in the trabecular meshwork leading to rise in IOP.
Oral/systemic steroids when used for longer duration are known to cause posterior subcapsular cataract.

ANTIBACTERIAL DRUGS

The commonly used antibiotic drugs are:

Sulfonamides like Sulfacetamide Eyedrops

Mechanism of Action

Being structural analog of para aminobenzoic acid it act by inhibiting bacterial folate synthetase. It is bacteriostatic in nature.

Indications

- Treatment of chlamydial infections like trachoma and inclusion conjunctivitis
- Treatment of ocular toxoplasmosis.

Aminoglycosides like Gentamicin, Tobramycin......

Mechanism of Action

They are bactericidal which primarily act against gram negative bacteria. They act by inhibiting protein synthesis by binding to ribosomes.

Indications

In infective conditions of eye like bacterial corneal ulcer, bacterial conjunctivitis, postoperatively after surgeries like cataract surgery, keratoplasty... as prophylactic to prevent secondary bacterial infections…

Fluoroquinolones like Ciprofloxacin, Ofloxacin, Moxifloxacin...

Mechanism of Action

They act by inhibiting bacterial DNA gyrase.

Indications

In infective conditions of eye like bacterial corneal ulcer, bacterial conjunctivitis, postoperatively after surgeries like cataract surgery, keratoplasty... as prophylactic to prevent secondary bacterial infections…

ANTIVIRAL DRUGS

Commonly used antiviral drugs are acyclovir a purine analogue and Idoxuridine a pyrimidine analogue.

Acyclovir

Dosage 3 percent eye ointment 5 times per day for topical application and 400 to 800 mg up to 5 times per day for oral administration.

Mechanism of Action

Acts by inhibiting DNA polymerase.

Indications

Topical eye ointment in
- Herpes simplex virus (HSV) blepharitis
- HSV conjunctivitis
- HSV corneal epithelial keratitis
- Along with steroids in treatment of immune stromal keratitis.

Oral acyclovir is indicated in

- Herpes zoster ophthalmicus
- Prophylaxis against recurrent corneal epithelial keratitis.

Adverse Effects

- Lacrimal punctual occlusion
- Superficial punctuate keratitis
- Follicular conjunctivitis

ANTIFUNGAL DRUGS

Antifungal drugs used in ophthalmology are described below:

Polyenes: Natamycin 5 percent, Amphotericin B 0.15 percent

Mechanism of Action

They act by interacting with ergosterol present in cell membrane of fungi making cell membrane to become leaky resulting in loss of vital contents of cell.

Indications

Natamycin 5 percent is the first choice in *Fusarium keratitis*.

Amphotericin B 0.15 percent is the first choice in *Aspergillus* keratitis, *Candida* keratitis, *Dematiaceous* keratitis.

> Amphotericin eyedrops are not available commercially, it has to be prepared by intravenous preparation by adding 5 percent dextrose.

Triazoles: Fluconazole 0.3 percent, Fluconazole 200 mg, Itraconazole 200 mg

Mechanism of action: They act by preventing demethylation of lanosterol by inhibiting the action of demethylase in fungi there by preventing the formation of ergosterol from lanosterol.

Indications

They are effective against *Candida*, hence used in *Candida* keratitis. Oral triazoles are used in all cases of fungal keratitis as second line drugs along with topical natamycin.

Imidazoles: Ketaconazole 200 mg, Ketaconazole 2 percent Eyedrops

Ketaconazole is moderately effective in fungal keratitis, hence used as second line drug in fungal keratitis. Its mechanism of action is similar to triazoles.

NONSTEROIDAL ANTI-INFLAMMATORY DRUGS

Commonly used nonsteroidal anti-inflammatory drugs (NSAIDs) are flurbiprofen 0.3 percent and ketorolac 0.5 percent.

Mechanism of Action

They act by inhibiting the enzme cyclo-oxygenase which inhibits prostaglandin synthesis.

Indications

To prevent cystoid macular edema postoperatively after cataract surgery NSAIDs are started before surgery and continued in the postoperative period up to 6 weeks. NSAIDs also help to maintain the pupillary dilatation during cataract surgery.

Other indications are in allergic conjunctivitis, episcleritis, inflammed pterygium.

LOCAL ANESTHETIC DRUGS

Commonly used local anesthetic drugs are lignocaine, bupivacaine and proparacaine.

Mechanism of Action

They act by decreasing the entry of sodium ions during upstroke of action potential.

4 percent lignocaine and 0.5 percent proparacaine are used for topical anesthesia.

2 percent lignocaine (duration of action-1–2 hours) and 0.5 percent bupivacaine (duration of action 3–6 hours) are used for infiltration anesthesia.

Indications

Surface Anesthesia

For removal of corneal and conjunctival foreign bodies.

For procedures like lacrimal syringing, tonometry, corneal scraping.

Infiltration Anesthesia

For performing intraocular surgeries like cataract surgery, trabeculectomy, squint surgery, keratoplasty, pterygium excision.

INJECTION HYALURONIDASE

Hyaluronidase 50 units/ml in peribulbar anesthesia is used to increase diffusion of anesthetic agent by breaking hyaluronic acid present in cell membranes.

VISCOELASTICS

They are substances with dual properties which act as viscous liquids as well as elastic solids.

They are used to prevent damage to corneal endothelium and other vital intraocular structures during intraocular surgery.

Methyl cellulose and sodium hyaluronate are the commonly used viscoelastic agents.

Indications

They are used in intraocular surgeries like cataract surgery, trabeculectomy, keratoplasty.... to maintain deep anterior chamber and to prevent damage to corneal endothelium.

ARTIFICIAL TEARS

They are used as tear substitutes in patients with dry eye.

They contain viscoagents like sodium hyaluronate, methyl cellulose or polyvinyl alcohol which improve tear retention.

SUTURES

Both absorbable and non absorbable sutures are used in ophthalmology.

Non absorbable sutures are preferred for corneal suturing, conjunctival suturing…

Absorbable sutures are preferred in squint surgeries, DCR, Scleral suturing...

Non absorbable sutures: nylon 10-0, 9-0 is preferred for corneal suturing.

Absorbable sutures: vicryl 6-0 is used in squint surgeries, DCR…

DYES

Trypan blue, fluorescein sodium, indocyanine green….

Trypan blue is used to stain anterior capsule for performing capsulorhexis in ECCE.

Fluorescein sodium and indocyanine green are described under diagnostic tests in ophthalmology.

CHAPTER

9

COMMON OPHTHALMIC SURGERIES

CHAPTER OUTLINE

- Anesthesia
- Cataract Surgery
- Trabeculectomy
- Evisceration
- Enucleation
- Pterygium Excision
- Keratoplasty
- Dacryocystectomy
- Dacryocystorhinostomy
- Incision and Curettage of Chalazion

ANESTHESIA

General Anesthesia

Indications

For performing ophthalmic surgeries in children, mentally retarded and non cooperative adult patients.

For destructive operations like evisceration, enucleation, exenteration to avoid psychological trauma (they can also be done under local anesthesia).

For repair of perforating or penetrating injuries involving eye ball.

Local Anesthesia

It can be either surface (topical) anesthesia or infiltration anesthesia.

Surface anesthesia: This is done by instillation of 4 percent Lignocaine or 0.5 percent proparacaine.

Indications

- Outpatient office procedures like tonometry, gonioscopy, subconjunctival injection lacrimal syringing, A-scan....
- Removal of corneal foreign body, conjunctival foreign body…

Infiltration anesthesia: This is done by injecting 2 percent lignocaine or 0.5 percent bupivacaine. Infiltration anesthesia can be:

- Retrobulbar anesthesia
- Peribulbar anesthesia
- Sub-Tenon anesthesia
- Intracameral anesthesia (Injection of anesthetic agent into anterior chamber)
- Facial block.

Drugs used along with local anesthetic agents:

Adrenaline 1 in 1 lakh units to reduce systemic absorption of local anesthetic agent and to prolong the duration of action.

Hyaluronidase 50 units/ml in peribulbar anesthesia to increase diffusion of anesthetic agent by breaking hyaluronic acid present in cell membranes.

Peribulbar block is best achieved by using both 2 percent lignocaine (for rapid onset of action) with adrenaline and 0.5 percent bupivacaine(for longer duration of action) with hyaluronidase.

Retrobulbar anesthesia:

The principle is to block the sensory nerves and motor nerves which supply the extraocular muscles before they innervate the extraocular muscles in the posterior conal space (superior oblique muscle is not anesthesized because 4th nerve has extraconal course and it escapes from the block) **(Fig.9.1)**.

It provides excellent anesthesia and akinesia with quick onset of action.

Disadvantages:

Complication rate is higher, complications associated with it are:

- Retrobulbar hemorrhage
- Ocular perforation
- Injury to optic nerve
- Brain stem anesthesia.

Peribulbar anesthesia:

The principle is to place local anesthetic agent outside the muscle cone and allow the anesthetic agent to diffuse into muscle cone to cause anesthesia. Injection hyaluronidase is used to assist the anesthetic agent to diffuse across the muscle cone.

The complications rate is low hence it is the preferred technique over retrobulbar anesthesia.

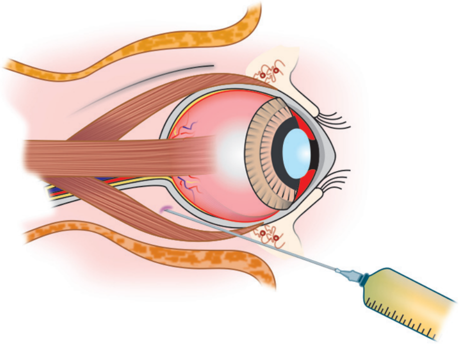
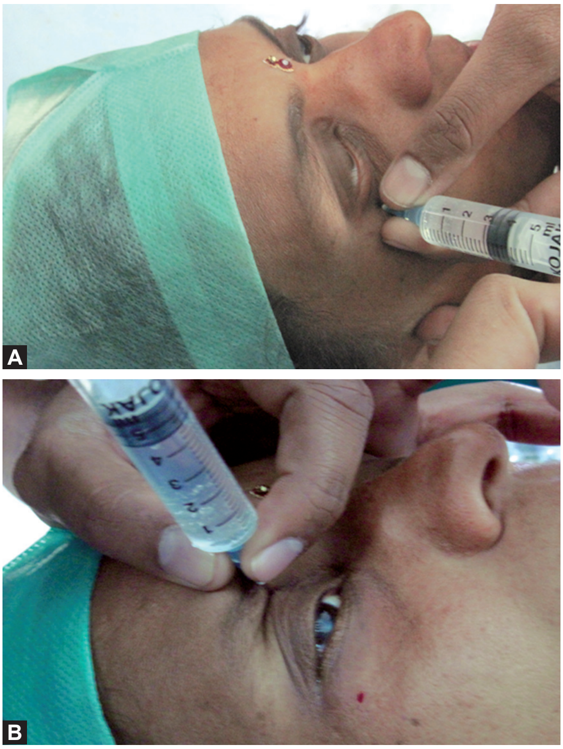


Fig. 9.1: Retrobulbar anesthesia

Disadvantages:

Delayed onset as the anesthetic agent has to diffuse from peribulbar space to retrobulbar space.

All complications of retrobulbar anesthesia can occur with this also but with very less frequency **(Figs 9.2A and B and 9.3)**.



Figs 9.2A and B: Technique of peribulbar block

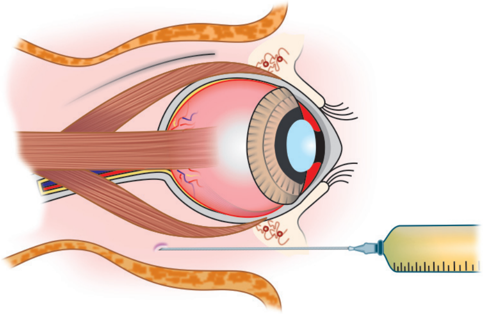


Fig. 9.3: Peribulbar anesthesia

Sub-Tenon's anesthesia:

The principle is to inject anesthetic agent into sub-Tenon's space to block sensory nerve endings to cause anesthesia, but it will not cause akinesia as it will not block motor nerves.

Intracameral anesthesia:

The principle is to inject anesthetic agent into anterior chamber to anesthetize iris and ciliary body to carry out procedures in anterior chamber. It is used in association with topical anesthesia for phacoemulsification.

Facial block:

The principle is to block facial nerve either its main branch or its peripheral branches to anesthetize orbicularis oculi to prevent squezing of eye lids during intraocular surgeries.

Van Lint's method: Infiltration of anesthesia along superolateral and inferolateral margin of orbit to block peripheral branches of facial nerve.

Atkinson's method: Facial nerve block over zygomatic arch.

O'Brien's method: Facial nerve block over mandibular condyle.

Nadbath-Rehman method: Facial nerve block (of the main trunk) just below the external auditory meatus **(Fig. 9.4)**.

Other types of infiltration anesthesia used in ophthalmology:

Frontal nerve block

Supraorbital nerve block

Supratrochlear nerve block

Infratrochlear nerve block

Lacrimal nerve block

Infraorbital nerve block

Anesthesia for DCR (Dacryocystorhinostomy):

Local skin incision injection

Infratrochlear nerve block by inserting needle below trochlea

Infraorbital nerve block by inserting the needle at the junction of inferior orbital margin with anterior lacrimal crest

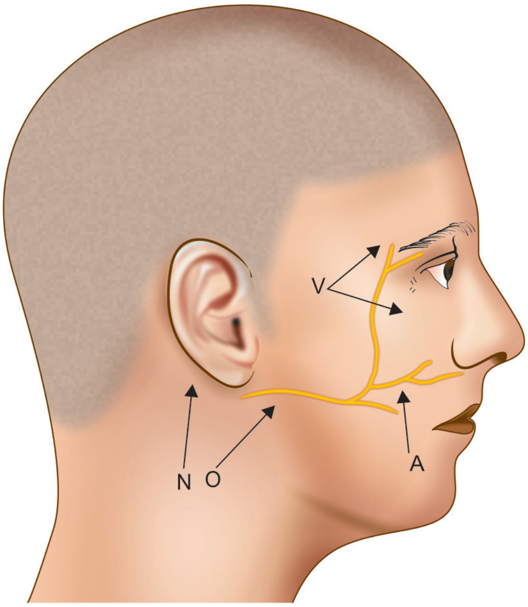


Fig. 9.4: Techniques of facial block

Abbreviations: V: Site of Van Lint facial block; A: Site of Atkinson facial block; O: Site of O'Brien facial block; N: Site of Nadbath-Rehman facial block

Anesthesia of nasal mucosa by packing nose with a guaze piece moistened with lignocaine

CATARACT SURGERY

The techniques for cataract surgery have undergone evolution starting from couching (applying pressure on the eyeball to dislocate the intact lens into vitreous chamber so that patient becomes aphakic and will have aphakic vision which is better than vision with mature and hypermature cataracts!) which was practiced by Susruta, father of surgery. The various techniques of cataract surgery are described below **(Table 9.1)**.

- ICCE (Intracapsular cataract extraction)
- ECCE (Extracapsular cataract extraction)
  - ECCE conventional
  - SICS (Small incision cataract surgery)
  - Phacoemulsification.

Indications for Cataract Surgery

Optical: To improve vision when cataract is causing visual impairment.

Therapeutic: As treatment for lens induced glaucomas and in treatment of posterior segment problems like diabetic retinopathy, retinal detachment when lens opacity is preventing the treatment of posterior segment problems.

Cosmetic: Cataract surgery to obtain black pupil with no visual prognosis in conditions where cataract is associated with posterior segment diseases like optic atrophy....

Intracapsular Cataract Extraction

Entire cataractous lens is removed along with intact capsule.
Not done nowadays
The indication for ICCE is dislocated lens into anterior chamber.

ICCE:
Enzyme alpha chymotrypsin is used in young patients for performing ICCE to dissolve the zonules, in patients after 50 years of age this enzyme is not required as the zonules will not be strong.

Extracapsular Cataract Extraction

Cataractous lens is removed leaving behind intact posterior capsule. Types of ECCE are

- Conventional ECCE
- SICS (Small incision cataract surgery)
- Phacoemulsification.

Steps of ICCE

- Local anesthesia
- Preparation of the eye by painting the eye with povidone iodine and draping the eye with eye towel

Table 9.1: Comparison between various techniques of cataract surgery

Type of surgery	*ICCE*	*ECCE conventional*	*SICS*	*Phacoemulsification*
Indication	Not done now a days indicated only in cases of Dislocated lens into anterior or posterior chamber	All other cases	All other cases	All other cases
Principle	Lens is removed completely with both anterior and posterior capsules	Anterior capsule is removed by anterior capsulotomy and lens is removed leaving behind posterior capsule	Anterior capsule is removed by anterior capsulotomy and lens is removed leaving behind posterior capsule	Anterior capsule is removed by anterior capsulorhexis and lens is removed leaving behind posterior capsule nucleus is emulsified by ultrasonic energy using phacoemulsifier machine
Anesthesia	Peribulbar block	Peribulbar block	Peribulbar block	Peribulbar sub-tenon's topical anesthesia with intracameral anesthesia
Approach	Superior limbus	Superior limbus	Superior, superotemporal and temporal limbus	Superior, superotemporal, temporal limbus and clear corneal
Size of the incision	10 to 12 mm	8 to 10 mm	5.5 to 6.5 mm	3.5 mm
Methods of lens delivery	Lens is delivered intact (both cortex and nucleus with both anterior and posterior capsules) by cryoextraction or tumbling (pressure and counter pressure)	Nucleus is removed after anterior capsulotomy by pressure and counter pressure method Cortical matter is removed by irrigation and aspiration	Nucleus is expressed through tunnel after dialling the nucleus into anterior chamber after anterior capsulotomy or anterior capsulorhexis by Phaco sandwich or Phaco fracture or Irrigating vectis or Fish hook technique or Blue menthal technique. Cortical matter is removed by irrigation and aspiration	Nucleus is emulsified by a vibrating needle using ultrasonic energy Cortical matter is removed by irrigation and aspiration

Contd...

Contd...

Type of surgery	*ICCE*	*ECCE conventional*	*SICS*	*Phacoemulsification*
IOL	Only anterior chamber IOL can be implanted	Rigid PC IOL	Rigid PC IOL	Foldable PC IOL
Sutures	Incision needs to be sutured	Incision needs to be sutured	Sutures not required	Sutures not required
Complications	More because of vitreous disturbances	Less	Less	Less
Astigmatism induced by surgery	Average astigmatism >2 D	Average astigmatism 1 D TO 2 D	Average astigmatism 0.5 D TO 1 D	Average astigmatism 0.5 D
Visual rehabilitation	8 weeks	8 weeks	6 weeks	4 weeks
Advantages	It was widely practiced before the advent of microsurgery, now it is completely replaced by microsurgery(surgery using microscope), i.e ECCE. It was an easy procedure without need for microscope which was the scenario in underdeveloped and developing countries especially in eye camps	It has less postoperative complications when compared to ICCE	Because of its self-sealing incision it is preferred over conventional ECCE and it has got less complications particularly in relation to postoperative astigmatism	Because of its sutureless small incision, it is now the surgery of choice
Disadvantages	More incidence of vitreous related complications like vitreous touch syndrome. Only anterior chamber IOL can be inserted which is not the ideal condition	The incision needs suturing hence carries the risk of surgically induced astigmatism	It stays in between conventional ECCE and Phaco	It is most expensive among all cataract surgeries hence affordability can be a problem. Most skillful and requires mastering over phacoemulsification machine to avoid machine related complications like corneal burns….

- Insertion of the wire speculum
- Superior rectus stitch or bridle suture for fixation of the globe
- Conjunctival peritomy and cauterization of the bleeding vessels
- Partial thickness limbal groove 10 – 12 mm
- Corneoscleral section
- Iridectomy
- Lens delivery by cryoextraction or tumbling
- Anterior chamber IOL insertion
- Formation of anterior chamber by balanced salt solution
- Closure of the corneoscleral incision
- Closure of conjunctiva
- Subconjunctival injection of antibiotic with steroid
- Pad and bandage.

Steps of ECCE Conventional

- Local anesthesia, peribulbar block is the preferred one
- Preparation of the eye by painting the eye with povidone iodine and draping the eye with eye towel
- Insertion of the wire speculum
- Superior rectus stitch or bridle suture for fixation of the globe
- Conjunctival peritomy and cauterization of the bleeding vessels
- Partial thickness limbal groove 8 – 10 mm
- Anterior capsulotomy or capsulorrhexis
- Corneoscleral section
- Hydrodissection

Removal of nucleus and cortical matter

- IOL insertion (posterior chamber IOL)
- Formation of anterior chamber by balanced salt solution
- Closure of the corneoscleral incision
- Closure of conjunctiva
- Subconjunctival injection of antibiotic with steroid
- Pad and bandage.

Recent advances in cataract surgery:

Micro incision cataract surgery (**MICS**). This involves removal of cataract through a 1.6 – 1.8 mm incision and implantation of ultrathin foldable IOL.

Ultra small incision cataract surgery-**PHAKONIT** phacoemulsification with **n**eedle opening via ultra small **i**ncision with sleeveless ultrasound Tip. The size of the incision is 0.9 mm.

Femtosecond laser cataract surgery using laser **(Figs 9.5 to 9.8).**

TRABECULECTOMY

It is a partial thickness filtering operation where a part of trabecular meshwork is excised along with partial thickness of sclera.

Fig. 9.5: Ophthalmology OT Surgeon operating under microscope

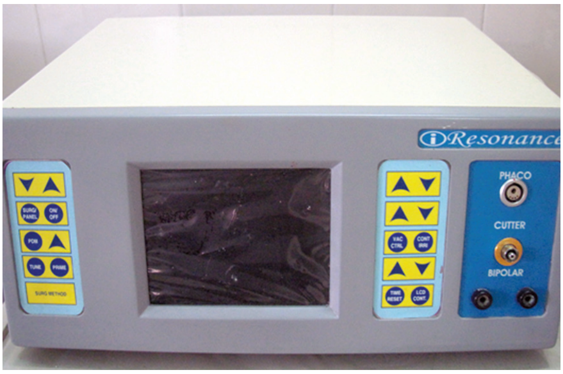


Fig. 9.6: Phacoemulsification machine

Indications

- Primary open angle glaucoma not controlled by maximum medical treatment
- Primary angle closure glaucoma with peripheral anterior synechiae involving more than half of the angle
- Developmental and congenital glaucomas.

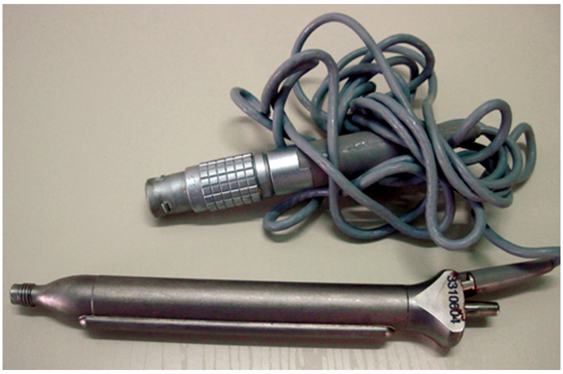


Fig. 9.7: Phacoemulsification hand piece

Procedure

- *Anesthesia:* Peribulbar block
- After anesthesia and preparing of the eye speculum is inserted
- Limbal based conjunctival flap
- Hemostasis by cauterizing the bleeding vessels
- Dissection of a superficial scleral flap
- Excision of deep sclera along with trabecular tissue
- Peripheral iridectomy
- Suturing of superficial scleral flap
- Closure of conjunctival flap
- Pad and bandage.

Mechanism of Action of Trabeculectomy

Filtration

- Around the scleral flap margins
- Through outlet channels of the scleral flap
- Through connective tissue substance of scleral flap

Fig. 9.8: Patients with pad and bandage after cataract surgery at our ophthalmology wards

- Through cut ends of the Schlemm's canal.

Aqueous fluid is made to enter the subconjunctival tissue from one of the above ways (resulting in formation of conjunctival bleb) and it gets absorbed, thus increasing filtration.

Complications

- Bleb failure leading to inadequate filtration and failure to control intraocular pressure
- Overfiltration leading to excess filtration causing hypotony
- Bleb related infection.

Antimetabolites in glaucoma filtration surgery:

Successful glaucoma filtration surgery is indicated by the formation of cystic filtering bleb which results in drainage of aqueous humor from anterior chamber to the subconjunctival space. Failure of filtration is due to episcleral scarring.

Antimetabolites are used in glaucoma surgery to prevent scarring by inhibiting the proliferation of fibroblasts.

5-Fluorouracil and Mitomycin-C are commonly used agents.

Indications for antimetabolites use in glaucoma filtering surgery.

Previously failed glaucoma filtering surgery.

Glaucomas with high risks of failure like aphakic glaucoma, pseudophakic glaucoma, neovascular glaucoma.

EVISCERATION

It is a surgical procedure which involves removal of intraocular contents leaving sclera and optic nerve.

Indications

- Panophthalmitis
- Blind and disfigured eyes with staphyloma

Anesthesia: General anesthesia is preferred but can also be done under local anesthesia.

Procedure

- After anesthesia and preparing of the eye speculum is inserted
- Dissection of conjunctiva all around the limbus
- Complete excision of cornea with limbus
- Introduction of evisceration scoop to separate uveal tissue from sclera and uveal tissue and intraocular contents are scooped out
- Hemostasis is achieved with warm saline soaked guaze
- Silicone ball implant is placed in the scleral cup
- Sclera, tenon's capsule and conjunctiva are sutured separately
- Pad and bandage.

ENUCLEATION

Enucleation is a surgical procedure which involves removal of eye ball along with a portion of optic nerve.

Indications

- To collect eye ball from eye donors after their death is the most common indication
- Malignancies of eye like retinoblastoma, malignant melanoma
- Sympathetic ophthalmitis
- Endophthalmitis not responding to medical treatment.

Contraindications

Panophthalmitis, as the infection may spread via the cut ends of optic nerve sheath.

Anesthesia: General anesthesia is preferred but can also be done under local anesthesia. No anesthesia is required to collect eyeball from donors which is collected only after death of donors.

Procedure

- After anesthesia and preparing of the eye speculum is inserted
- Dissection of conjunctiva all around the limbus
- Four recti muscles are hooked and cut
- Optic nerve is cut with a enucleation scissors
- Oblique muscles are cut
- Eyeball is removed
- Hemostasis is achieved with warm saline soaked guaze
- Tenon's capsule and conjunctiva are sutured separately
- Pad and bandage.

PTERYGIUM EXCISION

KERATOPLASTY

DACRYOCYSTECTOMY

DACRYOCYSTORHINOSTOMY

INCISION AND CURETTAGE OF CHALAZION

These above surgeries are described under respective case discussion.

CHAPTER

10

AN APPROACH TO A PATIENT WITH RED EYE

CHAPTER OUTLINE

- Subconjunctival Hemorrhage
- Blepharitis
- Conjunctivitis
- Inflamed Pterygium
- Episcleritis
- Scleritis
- Corneal Abrasion
- Infective and Noninfective Keratitis
- Endophthalmitis
- Panophthalmitis
- Orbital Cellulitis
- Acute Iridocyclitis
- Acute Congestive Glaucoma

Differential diagnosis of acute red eye

Three classical differential diagnosis of this condition are:

1. Acute conjunctivitis.
2. Acute iridocyclitis.
3. Acute congestive glaucoma.

Causes of red eye: Include causes for acute red eye and other causes like

- Blepharitis
- Conjunctivitis
- Subconjunctival hemorrhage
- Episcleritis
- Scleritis
- Corneal abrasion
- Infective and noninfective keratitis
- Endophthalmitis
- Panophthalmitis
- Orbital cellulitis.

SUBCONJUNCTIVAL HEMORRHAGE

Collection of blood under the bulbar conjunctiva is called subconjunctival hemorrhage.

Causes

Trauma is the most common cause. The mode of trauma may vary from very trivial one to very serious one like head injury, orbital wall fractures….

Other causes include hemorrhagic conjunctivitis caused by picornaviruses, pneumococci…, bleeding disorders, spontaneous rupture of blood vessels in patients with microvascular diseases like diabetes, hypertension…

Examination

Posterior limit of the subconjunctival hemorrhage has to be made out clearly, if posterior limit cannot be made out retrobulbar hemorrhage has to be ruled out particularly in patients with history of moderate-to-severe eye trauma or head injury.

Look out for other causes of subconjunctival hemorrhage in patients with no history of trauma.

Evaluate for diabetes and hypertension in patients with spontaneous subconjunctival hemorrhage.

Treatment

Subconjunctival hemorrhage alone will not require treatment other than reassurance and advice that it will resolve over a period of 4 weeks.

Red Eye

Painless and with no visual involvement	*Mild pain/irritation with no visual involvement*	*Moderate-to-severe pain with various grades of visual impairment*
• Subconjunctival hemorrhage	• Blepharitis • Conjunctivitis • Inflamed pterygium • Episcleritis	• Scleritis • Corneal abrasion • Infective and noninfective keratitis • Endophthalmitis • Panophthalmitis • Orbital cellulitis • Acute iridocyclitis • Acute congestive glaucoma

BLEPHARITIS

Inflammation of lid margin is called blepharitis.

Causes

- Infective like staphylococcal ulcerative blepharitis
- Noninfective like seborrheic or squamous blepharitis
- Meibomianitis.

Examination

Blepharitis usually presents with scales at lid margins in squamous blepharitis, crusts (ulcers on removing crusts) in staphylococcal ulcerative blepharitis, yellowish spots in meibomianitis.

Treatment

Treatment is by lid hygiene, antibiotic-steroid eyedrops/ointment (only antibiotic eyedrops/ointment in ulcerative blepharitis).

CONJUNCTIVITIS

Inflammation of conjunctiva is called conjunctivitis.

Causes

- Infective causes including bacterial conjunctivitis, viral conjunctivitis
- Allergic conjunctivitis
- Traumatic conjunctivitis.

Examination

All varieties of conjunctivitis present with conjunctival congestion associated with discharge.

Bacterial conjunctivitis presents with mucopurulent or purulent discharge.

Viral conjunctivitis presents with watery discharge with follicles in conjunctiva.

Allergic conjunctivitis presents with ropy discharge with papillae in conjunctiva mainly in upper palpebral conjunctiva.

Treatment

Treatment depends on the causative agent.

Bacterial conjunctivitis is treated by appropriate antibiotic eyedrops.

Viral conjunctivitis treatment is mainly symptomatic and by antibiotic eyedrops to prevent secondary bacterial infection.

Allergic conjunctivitis is treated by antihistamine drugs, mast cell stabilizers, vasoconstrictors, steroid eyedrops.

INFLAMED PTERYGIUM

Pterygium presenting with complaints of inflammation is common in patients with preexisting pterygium usually on exposure to dust, wind.

Treatment

Treatment is by nonsteroidal anti-inflammatory agents like ketorolac eyedrops, flurbiprofen eyedrops or steroidal agents like fluorometholone eyedrops, dexamethasone eyedrops.

EPISCLERITIS

Inflammation of episclera with tenon's capsule is called episcleritis.

It presents with mild pain with sectoral congestion.

Treatment is by topical steroid eyedrops with or without systemic nonsteroidal drugs.

Recurrent episcleritis should be evaluated for autoimmune disorders as in case of scleritis.

SCLERITIS

Inflammation of sclera is called scleritis.

It presents with moderate-to-severe pain with sectoral congestion.

It is important because of its frequent association with autoimmune disorders. Hence, all cases of scleritis have to be evaluated for autoimmune diseases like rheumatoid arthritis, systemic lupus erythematosus, ankylosing spondylitis…., metabolic diseases like gout, thyroid disease… granulomatous diseases like tuberculosis, syphilis…

Work up of scleritis

ESR, C-Reactive protein
RA (Rheumatoid factor), ANA (Antinuclear antibody)
Serum uric acid
Thyroid function tests
Mantoux test, chest X-ray
VDRL/FTA-ABS (Fluorescent treponemal antibody test)

Treatment is by topical steroids and systemic steroids with nonresponsive cases requiring immunosuppressive agents.

CORNEAL ABRASION

Corneal epithelial defect is called corneal abrasion.

It presents with severe pain, photophobia, watering, circumcorneal congestion with various grades of visual impairment.

Examination

Search for the cause of corneal abrasion should be made in all cases, particularly look for a retained foreign body in sulcus subtarsalis by everting the upper eyelid. In all cases of corneal abrasion, cornea has to be stained with fluorescein and the size of the abrasion should be noted. Look for corneal dystrophies or degenerations like epithelial basement dystrophy in patients with recurrent corneal abrasion with no history of trauma.

Treatment

Treatment is mainly by antibiotic eyedrops/ointment to prevent secondary bacterial infection, lubricating eyedrops like methylcellulose eyedrops, cycloplegic eyedrops like homatropine eyedrops to relieve pain which is due to ciliary spasm.

Patients with lagophthalmos with corneal abrasion, which is not responding to treatment may require temporal or permanent tarsorrhaphy.

INFECTIVE AND NONINFECTIVE KERATITIS

Described under corneal ulcer.

ENDOPHTHALMITIS

Endophthalmitis is defined as inflammation of the inner coats (excluding outer fibrous coat) and cavities (vitreous chamber and anterior chamber) of the eyeball.

It can be infective following endogenous or exogenous infection by bacteria, fungi or parasite.

It can be sterile or toxic as following retained intraocular foreign body or toxic lens syndrome or phacoanaphylactic uveitis.

It presents with moderate-to-severe pain with grossly reduced visual acuity, lid edema, ciliary congestion, anterior chamber reaction, vitreous haze because of vitritis with normal extraocular movements.

Treatment

Treatment of sterile endophthalmitis is by controlling the inflammation by topical and systemic steroids.

Treatment of bacterial endophthalmitis is guided by endophthalmitis vitrectomy study (EVS) which suggests immediate vitrectomy if the presenting visual acuity is hand movements or less and in eyes with presenting visual acuity more than hand movements the initial management is by intravitreal antibiotics (ceftazidime and vancomycin are preferred). The use of systemic antibiotics showed no advantage in this study and hence not preferred.

Intravitreal antifungal agents like amphotericin B are indicated in fungal endophthalmitis initially, if not controlled vitrectomy is indicated.

PANOPHTHALMITIS

Panophthalmitis is defined as inflammation of all the three coats and cavities of the eyeball.

Panophthalmitis is usually infective condition and usually follows bacterial infections.

All the clinical features of endophthalmitis are present and added features like hazy cornea because of involvement of outer fibrous coat and limitation of extraocular movements.

Treatment

Medical management involves systemic antibiotics and analgesics to relieve pain and to prevent intracranial spread of infection.

Evisceration is the surgery of choice to prevent intracranial spread of infection which may be endangering life of the patient.

Enucleation is contraindicated in panophthalmitis as the infection may spread intracranially via cut ends of optic nerve following enucleation whereas following evisceration the intact scleral frill provides protection against this.

ORBITAL CELLULITIS

Orbital cellulitis is defined as suppurative inflammation of orbital fat and orbital cellular tissues.

It can present as milder form, preseptal orbital cellulitis or severe form postseptal orbital cellulitis.

Preseptal orbital cellulitis presents with periorbital swelling, pain, redness with normal visual acuity and full extraocular movements.

Postseptal cellulitis presents with severe proptosis, severe pain, chemosis, markedly reduced visual acuity and restricted ocular movements.

Treatment is mainly by systemic antibiotics and analgesic agents.

ACUTE IRIDOCYCLITIS

Acute inflammation of iris and ciliary body is called acute iridocyclitis.

The causes for acute iridocyclitis are very wide can be infective like bacterial infections, viral, fungal, parasitic….. trauma, hypersensitivity, autoimmune disorders, systemic diseases like diabetes mellitus, gout…. skin diseases like psoriasis.

Patient presents with moderate-to-severe pain, redness, photophobia, watering and diminision of vision. On examination the affected eye shows circumcorneal congestion, keratic precipitates, aqueous flare, aqueous cells, hypopyon, iris nodules, posterior synechiae.

Base line investigations in a patient with iridocyclitis:

Complete blood count
ESR
C-reactive protein
Chest X-ray
Mantoux test
VDRL/FTA-ABS
HIV
Rheumatoid factor
Antinuclear antibody

Treatment is by specific treatment of the cause and by nonspecific treatment which includes cycloplegic drugs like atropine 1 percent eye ointment, topical and systemic corticosteroids.

ACUTE CONGESTIVE GLAUCOMA

Glaucoma resulting due to sudden and total closure of the angle of the anterior chamber is called acute congestive glaucoma.

Patient presents with severe pain associated with nausea, vomiting…, diminision of vision, redness, photophobia, watering.

On examination the affected eye shows circum corneal congestion, corneal edema, shallow anterior chamber, mid dilated vertically oval pupil.

Patient may give history of previous intermittent attacks and the other eye may show shallow anterior chamber.

Treatment

Intravenous mannitol 20 percent 1.5–2 g/kg body weight over period of 45 minutes to one hour or oral glycerol in cases in which IV mannitol is contraindicated.

+

Oral acetazolamide 250 mg one or two tablets stat

+

Topical timolol 0.5 percent

+

Topical steroid eyedrops to control inflammation

+

Patient is asked to lie in supine position so that the iris lens diaphragm falls back there by increasing the anterior chamber depth.

Once IOP is controlled by the above measures, pilocarpine 2–4 and eyedrops 4 times per day are started.

If the IOP is controlled by above measures and once the corneal edema subsides and anterior chamber inflammation is controlled laser iridotomy or surgical iridectomy is done to eliminate pupillary block.

If the IOP increases on treatment with pilocarpine as in case of lens related angle closure, pilocarpine eyedrops are stopped and argon laser iridoplasty is done.

After laser iridotomy or surgical iridectomy or iridoplasty the patient is examined repeatedly at frequent intervals and following treatment is followed:

1. If the IOP is under control with open angle patient is examined frequently and followed up with optic disk changes, visual field defects as done for open angle glaucoma.
2. If the IOP is elevated with open angle medical treatment similar to open angle glaucoma is continued.
3. If the IOP is elevated with synechial angle closure less than 180 degrees argon laser trabeculoplasty is carried out.
4. If the IOP is elevated with synechial angle closure more than 180 degrees trabeculectomy is indicated.

Treatment of other eye is very important in every patient with acute congestive glaucoma. Other eye should be examined and if the anterior chamber is shallow and angle of the anterior chamber is narrow prophylactic laser iridotomy has to be done.

CHAPTER

11

EXAMINATION OF RETINA

CHAPTER OUTLINE

- Fundus Examination in Common Retinal Disorders
- Tractional Retinal Detachment
- Hypertensive Retinopathy
- Diabetic Retinopathy
- Central Retinal Artery Occlusion
- Branch Retinal Vein Occlusion
- Central Retinal Vein Occlusion
- Retinitis Pigmentosa
- Central Serous Retinopathy
- Cystoid Macular Edema
- Myopia
- Papilledema
- Optic Neuritis
- Optic Disk Changes in Glaucoma
- Primary Optic Atrophy
- Secondary Optic Atrophy
- Consecutive Optic Atrophy
- Important Dates in Ophthalmology

Retina is examined by following methods.

Ophthalmoscopy: Direct ophthalmoscopy and Indirect ophthalmoscopy.

Slit-lamp biomicroscopy: With accessory lenses like +78 D, +90 D, –58.6 D lenses, Goldmann's three mirror lens.

The visible portion of retina is referred as Fundus.

Fundus has to be examined under the headings.

Media

Normally media of the eye is clear or transparent. The media becomes hazy or opaque in case of opacities in the media like corneal opacity, cataract, vitreous hemorrhage.

Optic Disk

Size: Normal size of the optic disk is 1.5 mm in diameter.

Shape: Normal disk is circular in shape.

Color: Normal color of the optic disk is pink which is due to capillaries on the optic disk. It is chalky white in primary optic atrophy, dirty white in postneuritic optic atrophy and waxy white in consecutive optic atrophy.

Margin: Normal margin of the optic disk is sharp and well made out. It becomes blurred in optic neuritis, papilledema, drusen of the optic disk.

Cup: The central pale area of the optic disk is called as cup of the optic disk. It is obliterated in papilledema and papillitis.

Cup to disk ratio: Normal C:D ratio is about 0.2 to 0.4. It is increased in glaucoma and other causes of optic atrophy.

Neuroretinal rim: It is the part of the optic disk that is surrounding the cup. It is decreased or thin in glaucoma and in other causes of optic atrophy.

Abnormalities like hemorrhages on optic disk are seen in glaucoma, papilledema, papillitis.

Abnormalities like neovascularization of the disk seen in diabetic retinopathy, central retinal vein occlusion.

Macula

It is situated about 2 disk diameters lateral to the temporal margin of the optic disk. The central part of macula is called as foveola which shows as a bright reflex called as foveal reflex.

Macula has to be examined for abnormalities like macular edema, macular hole, macular hemorrhage, macular scarring, hard exudates at macula.

Vessels

Normal ratio of arteries to vein size is 2:3. *Vessels of the retina have to examined for:*

Narrowing of arteries as in central retinal artery occlusion, hypertensive retinopathy.

Dilatation and tortuosity of veins as in central retinal vein occlusion, angiomatosis, papilledema.

Neovascularization as in diabetic retinopathy, central retinal vein occlusion.

Pulsations of arteries and veins:
Arterial pulsations are always abnormal and seen in aortic regurgitation. Venous pulsations are normally seen and they are absent in papilledema.

General Background

Normally background of the retina is reddish pink in color. The background of retina has to be examined for abnormalities like superficial retinal hemorrhages seen in hypertensive retinopathy, diabetic retinopathy, central retinal vein occlusion.

Deep retinal hemorrhages seen in diabetic retinopathy.

Cotton wool spots seen in hypertensive retinopathy, diabetic retinopathy.

Hard exudates seen in hypertensive retinopathy, diabetic retinopathy.

The findings of retinal examination are documented on charts meant for documenting retinal examination findings **(Fig. 11.1)**.

The chart consists of three concentric circles divided into 12 meridians and each representing 1 clock hour. The outer circle corresponds to the junction of the pars plana and pars plicata, the

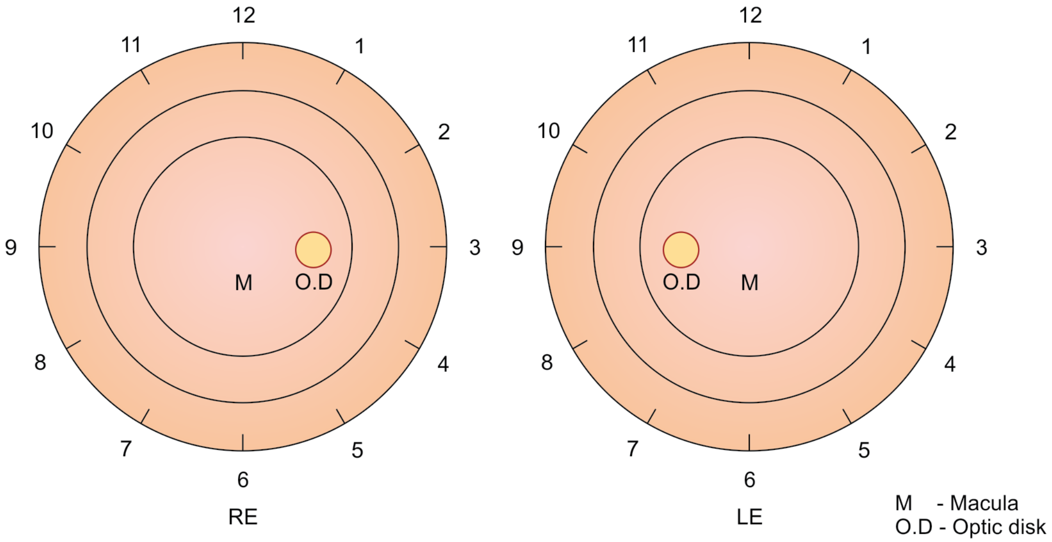


Fig. 11.1: Retinal chart

middle circle corresponds to ora serrata and the inner circle corresponds to equator. Macula is drawn in the center of the circle and optic disk is drawn nasal to it.

The image seen with the indirect ophthalmoscope is inverted vertically and reversed laterally. The chart is placed upside down and the findings are recorded exactly where they are seen and by this way the chart corresponds to the inverted image of the fundus.

The color codes used to document the lesions are as follows:

- Retinal veins—blue
- Flat or attached retina—red
- Detached retina—blue
- Retinal break—red with blue outline
- Thin retina—red hatching with blue outline
- Vitreous opacity—green
- Retinal pigment—black
- Lattice degeneration—blue hatching with blue outline

FUNDUS EXAMINATION IN COMMON RETINAL DISORDERS

Rhegmatogenous Retinal Detachment

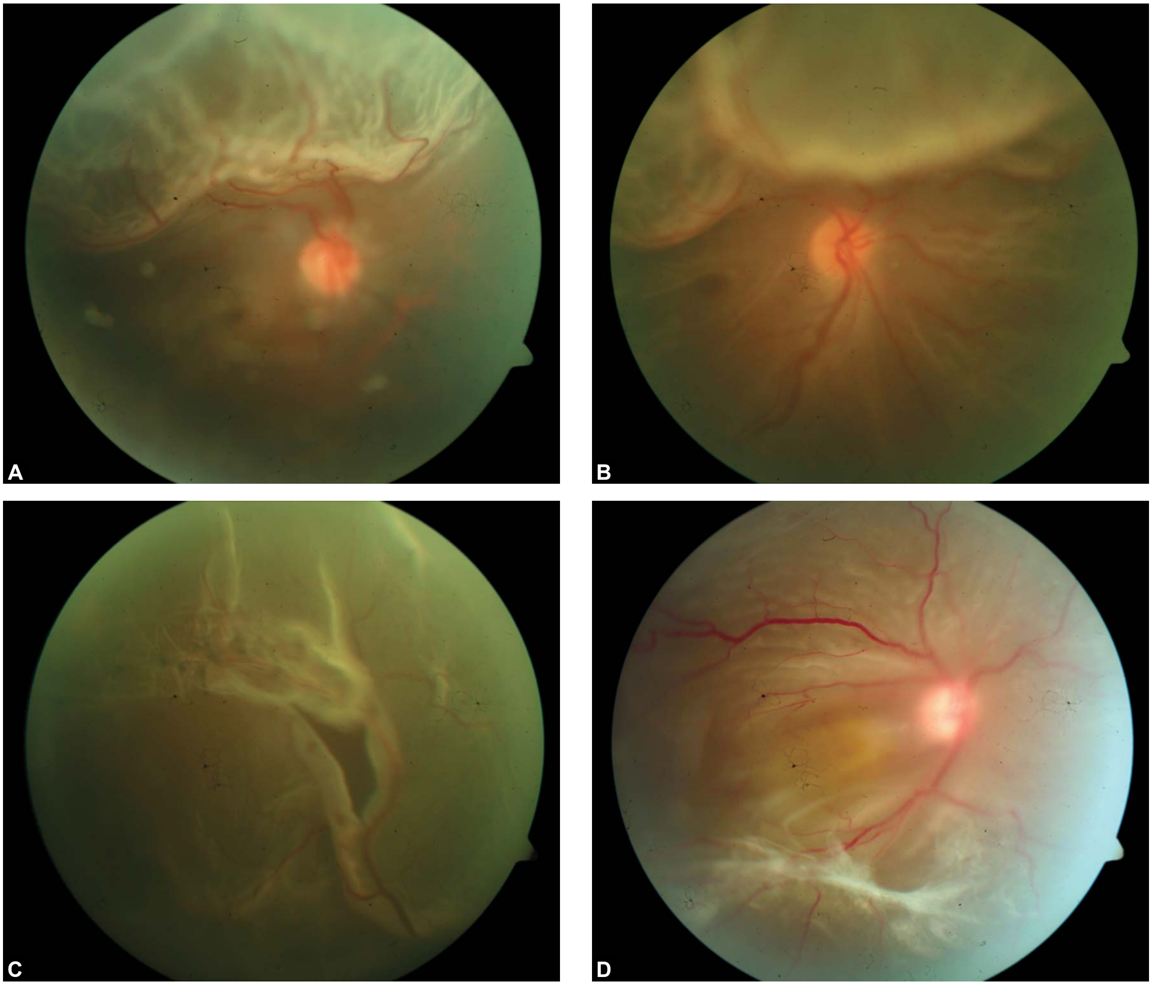
It occurs following a retinal break, through which subretinal fluid derived from liquified vitreous seeps and causes separation of neurosensory retina from pigment epithelium of retina.

In Fresh RD (Retinal Detachment)

- Detached retina is convex in configuration and corrugated appearance
- Detached retina undulates freely with ocular movements
- There is no shifting of fluid.

In Longstanding RD

- Retinal thinning
- Secondary intraretinal cysts
- Subretinal demarcation lines
- Proliferative vitreoretinopathy.



Figs 11.2A to D: Grayish, folded and raised retina seen in retinal detachment

Exudative Retinal Detachment

- It occurs due to the retina being pushed away by accumulation of subretinal fluid derived from choriocapillaries beneath the retina following inflammatory or vascular lesions or neoplastic lesions.
- Retinal breaks are absent
- Retinal detachment configuration is convex. The detached retina is smooth, non corrugated and bullous
- Shifting of fluid is the characteristic feature of exudative retinal detachment.

TRACTIONAL RETINAL DETACHMENT

- It occurs in conditions in which retina is pulled away from the retinal pigment epithelium by abnormal vitreoretinal traction as in proliferative retinopathies.
- Retinal breaks are absent.
- Retinal detachment configuration is concave.

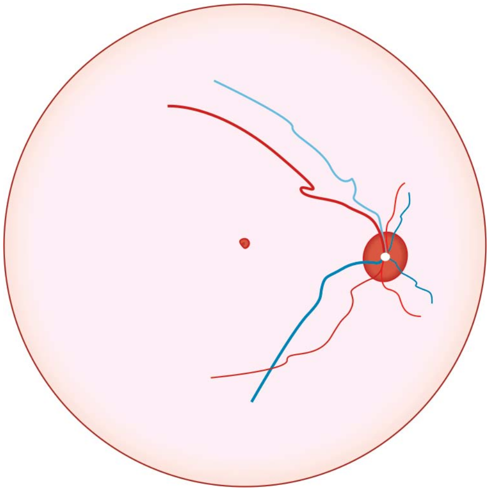


Fig. 11.3: Normal fundus-diagramatic representation

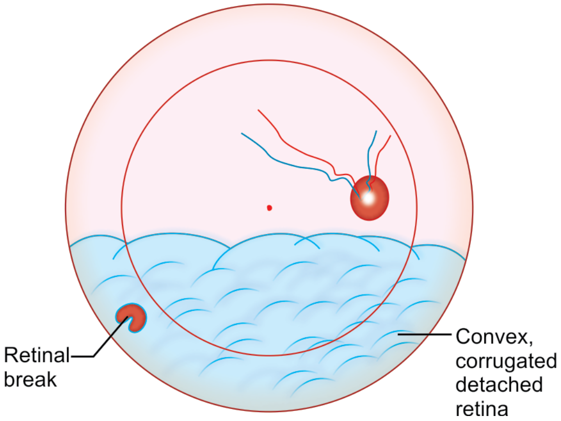

Retinal break
Convex, corrugated detached retina

Fig. 11.4: Rhegmatogenous retinal detachment

- Mobilityof the detached retina is severely reduced **(Fig. 11.7)**.

HYPERTENSIVE RETINOPATHY

Fundus changes occurring in patients with systemic hypertension are referred to as Hypertensive retinopathy.

Arteriovenous crossing changes in a case of hypertensive retinopathy are:

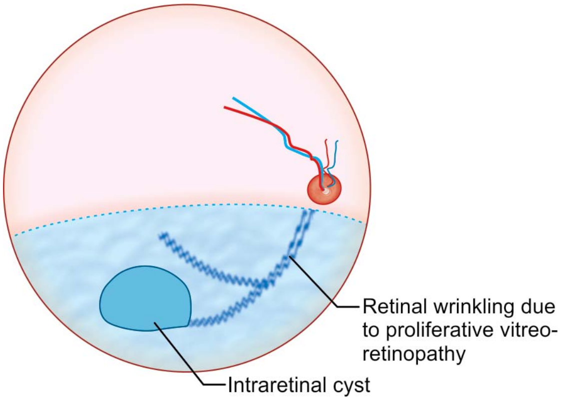

Retinal wrinkling due to proliferative vitreo-retinopathy
Intraretinal cyst

Fig. 11.5: Old rhegmatogenous detachment. *Note:* Subretinal demarcation line, intraretina cyst, retinal wrinkling due to proliferative vitreoretinopathy

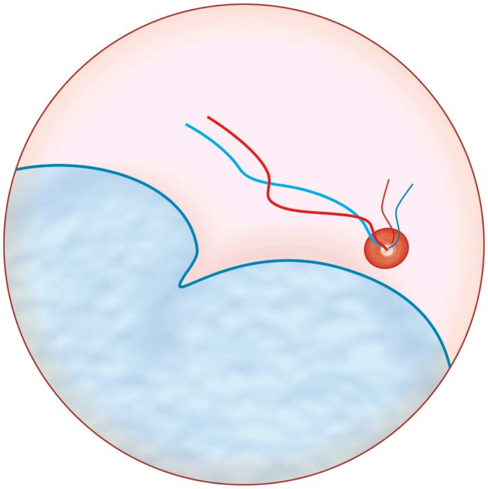


Fig. 11.6: Exudative retinal detachment. *Note:* Convex configuration of detached retina which is non-corrugated and bullous

Gunn's sign: Tapering of veins on either side of arteriovenous crossing.

Bonnet's sign: Dilatation of the veins distal to the arteriovenous crossing.

Salu's sign: Deflection of veins at arteriovenous crossing.

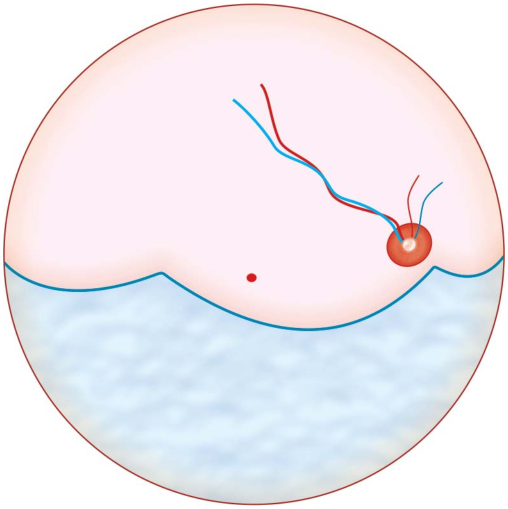


Fig. 11.7: Tractional retinal detachment. *Note:* Concave configuration of detached retina

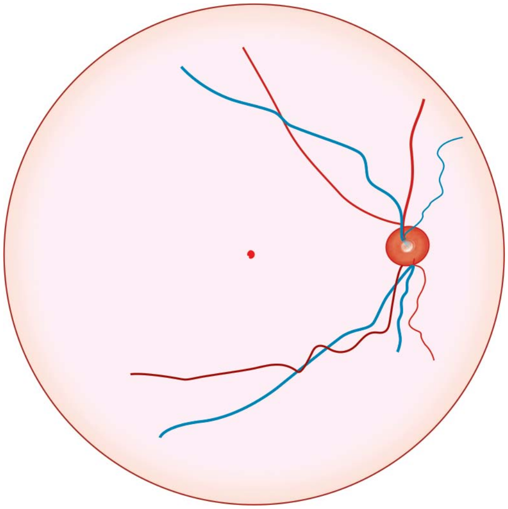


Fig. 11.8: Grade I HTN retinopathy. *Note:* Narrowing of retinal arteries

Table 11.1: Keith Wagner Barkar classification

Grade	*Description*
I	Mild narrowing of the retinal arteries (Fig. 11.8)
II	Moderate narrowing of the retinal arteries + regions of focal narrowing and arteriovenous nipping (Fig. 11.9)
III	Abnormalities seen in Grades I and II, + retinal hemorrhages, hard exudates and cotton-wool spots (Fig. 11.10)
IV	Abnormalities seen in Grades I, II, III,+ swelling of the optic nerve head and macular star (Fig. 11.11)

Arteriosclerotic changes seen in hypertensive retinopathy **(Table 11.1)** are graded as:

Grade I: Increased or widening of arteriolar light reflex.

Grade II: Copper wire appearance of the arterioles with moderate arteriovenous crossing changes.

Grade III: Silver wire appearance of the arterioles with marked arteriovenous crossing changes.

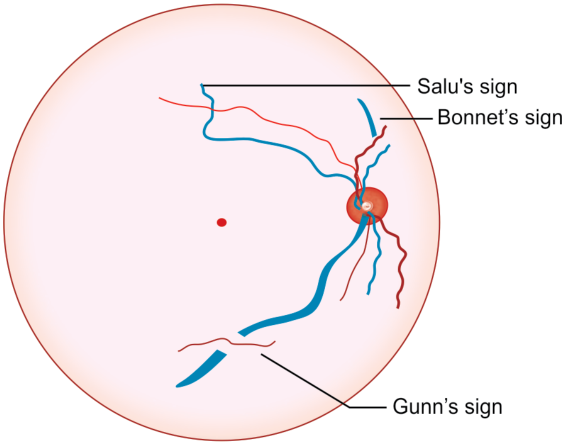


Fig. 11.9: Grade II HTN retinopathy. *Note:* Narrowing of retinal arteries + A-V crossing changes

Grade IV: Fibrous cord appearance of arterioles.

DIABETIC RETINOPATHY

Fundus changes occurring in patients with diabetes mellitus are referred to as diabetic retinopathy.

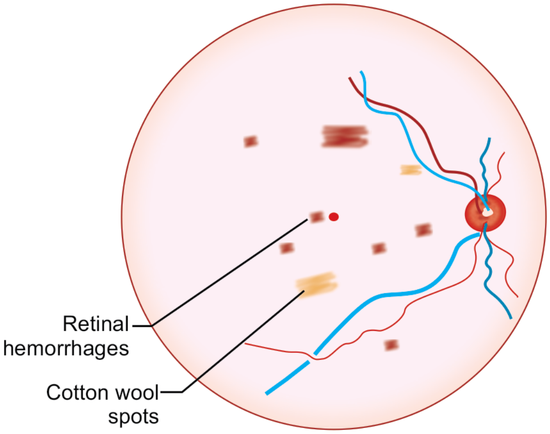


Fig. 11.10: Grade III HTN retinopathy. *Note:* Abnormalities seen in grade I and grade II + cotton wool spots, retinal hemorrhages

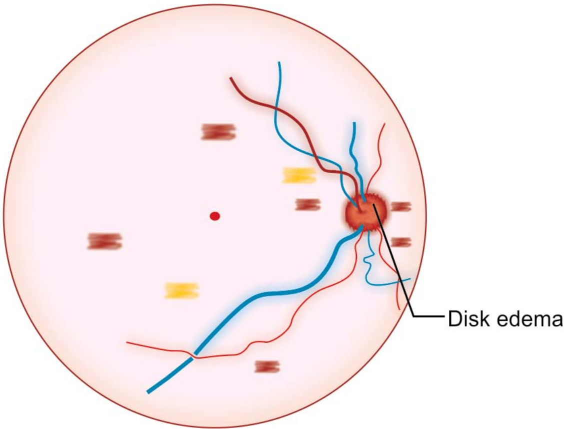
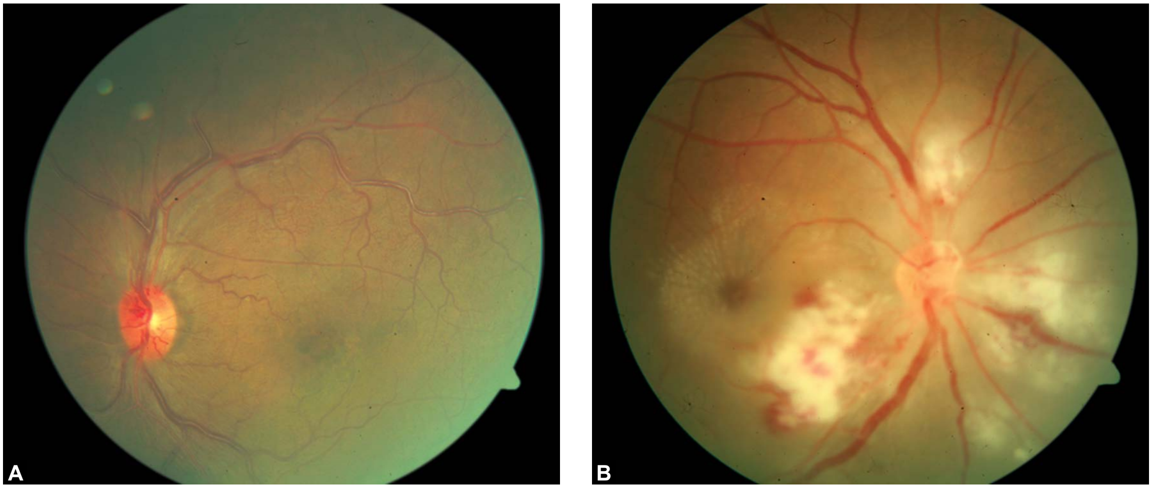


Fig. 11.11: Grade IV HTN retinopathy. *Note:* Abnormalities seen in Grade I, Grade II, Grade III + swelling of optic nerve head



Figs 11.12A and B: Hypertensive retinopathy. (A) *Grade II. Note:* Narrowing of arterioles and Salu's sign (deflection of veins at the arteriovenous crossings); (B) *Grade IV. Note:* Swelling of optic disk and macular star

Duration of diabetes is the most important risk factor for development of diabetic retinopathy.

Classification

Early treatment of diabetic retinopathy study (ETDRS) classification.

Nonproliferative diabetic retinopathy (NPDR)

- *Mild NPDR:* Microaneurysms, retinal hemorrhages and hard exudates in one or two quadrants **(Fig. 11.13)**.
- *Moderate NPDR:* Microaneurysms, retinal hemorrhages and hard exudates in three quadrants **(Fig. 11.14)**.
- *Severe NPDR:* Microaneurysms, retinal hemorrhages and hard exudates in four quadrants along with cotton wool spots, venous beading in more than two quadrants, intraretinal microvascular abnormalities (IRMA) in more than one quadrant **(Fig. 11.15)**.

Diabetic maculopathy: Macular edema seen

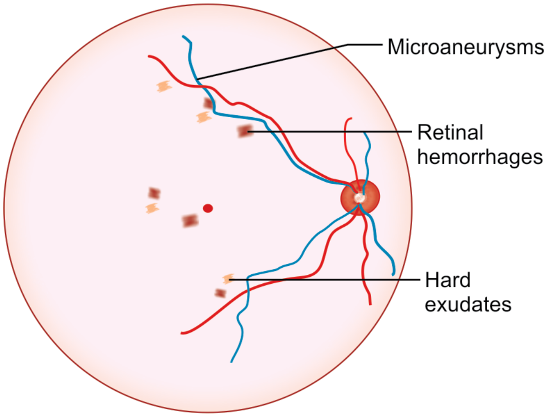


Fig. 11.13: Mild NPDR. *Note:* Microaneurysms, retinal hemorrhages hard exudates in two quadrants

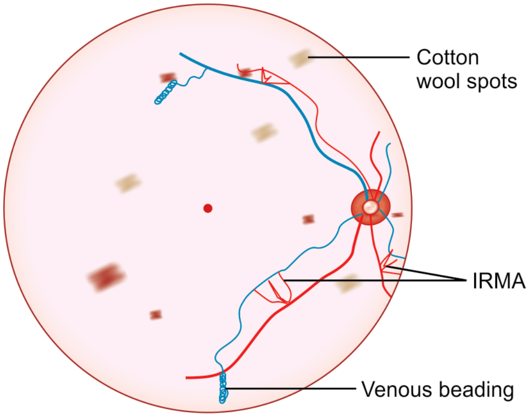


Fig. 11.15: Severe NPDR. *Note:* Microaneurysms, retinal hemorrhages, hard exudates in four quadrants + cotton wool spots, venous beading in two quadrants + IRMA in one quadrant (4–2–1 Rule)

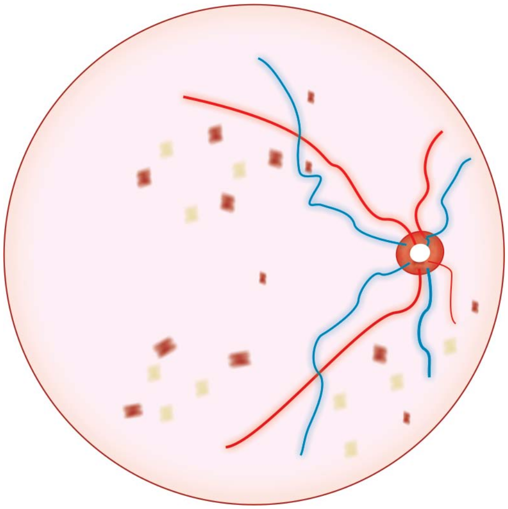


Fig. 11.14: Moderate NPDR. *Note:* Microaneurysms, retinal hemorrhages, hard exudates in three quadrants)

in diabetic retinopathy is called as diabetic maculopathy. It may be seen in NPDR or PDR.

It is called as clinically significant macular edema (CSME) if it has the following characteristics:

- Retinal edema within 500 micrometers of the center of the fovea
- Hard exudates within 500 micrometers of the center of the fovea associated with adjacent retinal edema.
- Retinal edema one disk area or larger, a part of which is within one disk diameter of the center of the fovea **(Figs 11.16A to C)**.

Proliferative Diabetic Retinopathy (PDR)

It is characterized by proliferation of new vessels, i.e. neovascularization at optic disk (NVD) or elsewhere (NVE) **(Fig. 11.17)**.

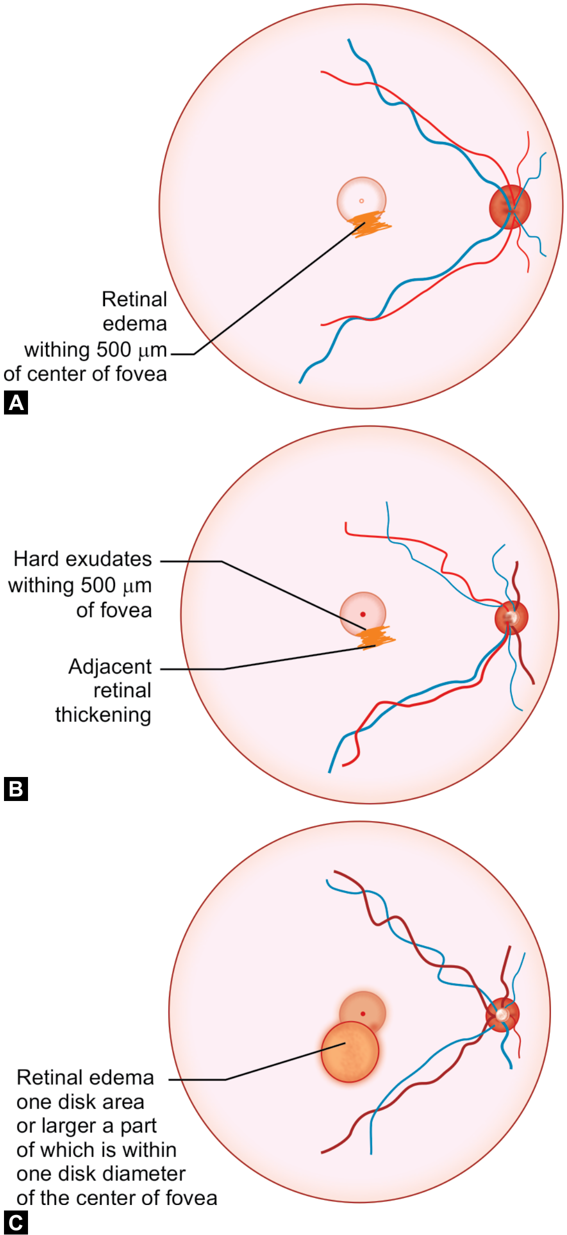
High risk characteristics of PDR are: NVD 1/4 disk area with vitreous hemorrhage or preretinal hemorrhage NVD 1/4 to 1/3 disk area with or without vitreous hemorrhage or preretinal hemorrhage **(Fig. 11.18)**.

NVE more than 1/2 disk area with vitreous hemorrhage or preretinal hemorrhage.

CENTRAL RETINAL ARTERY OCCLUSION

- It causes sudden painless diminision of vision to complete loss of vision.
- Causes for central retinal artery occlusion include thrombosis, embolism and arteritis.
- On examination relative afferent pupillary defect is seen on the affected side.

Examination of retina shows:


Retinal
edema
withing 500 µm
of center of fovea
A
Hard exudates
withing 500 µm
of fovea
Adjacent
retinal
thickening
B
Retinal edema
one disk area
or larger a part
of which is within
one disk diameter
of the center of fovea
C

Figs 11.16A to C: CSME

- Attenuation of retinal arteries
- Cattle track or box-car appearance of the arteries due to segmentation of blood column
- Retinal edema

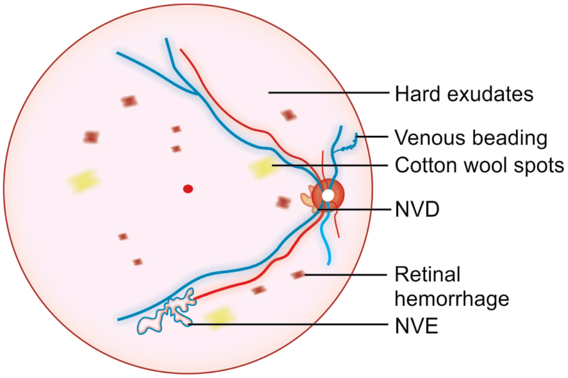

Hard exudates
Venous beading
Cotton wool spots
NVD
Retinal
hemorrhage
NVE

Fig. 11.17: PDR. *Note:* NVE and NVD

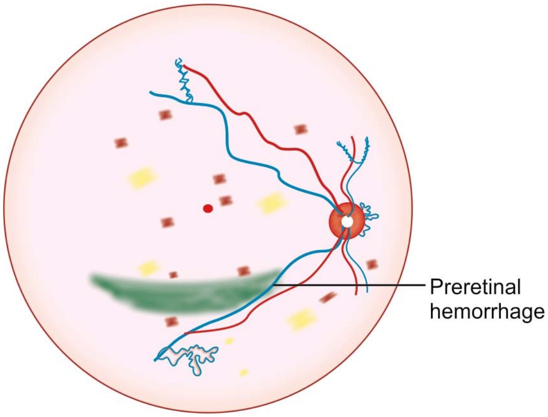
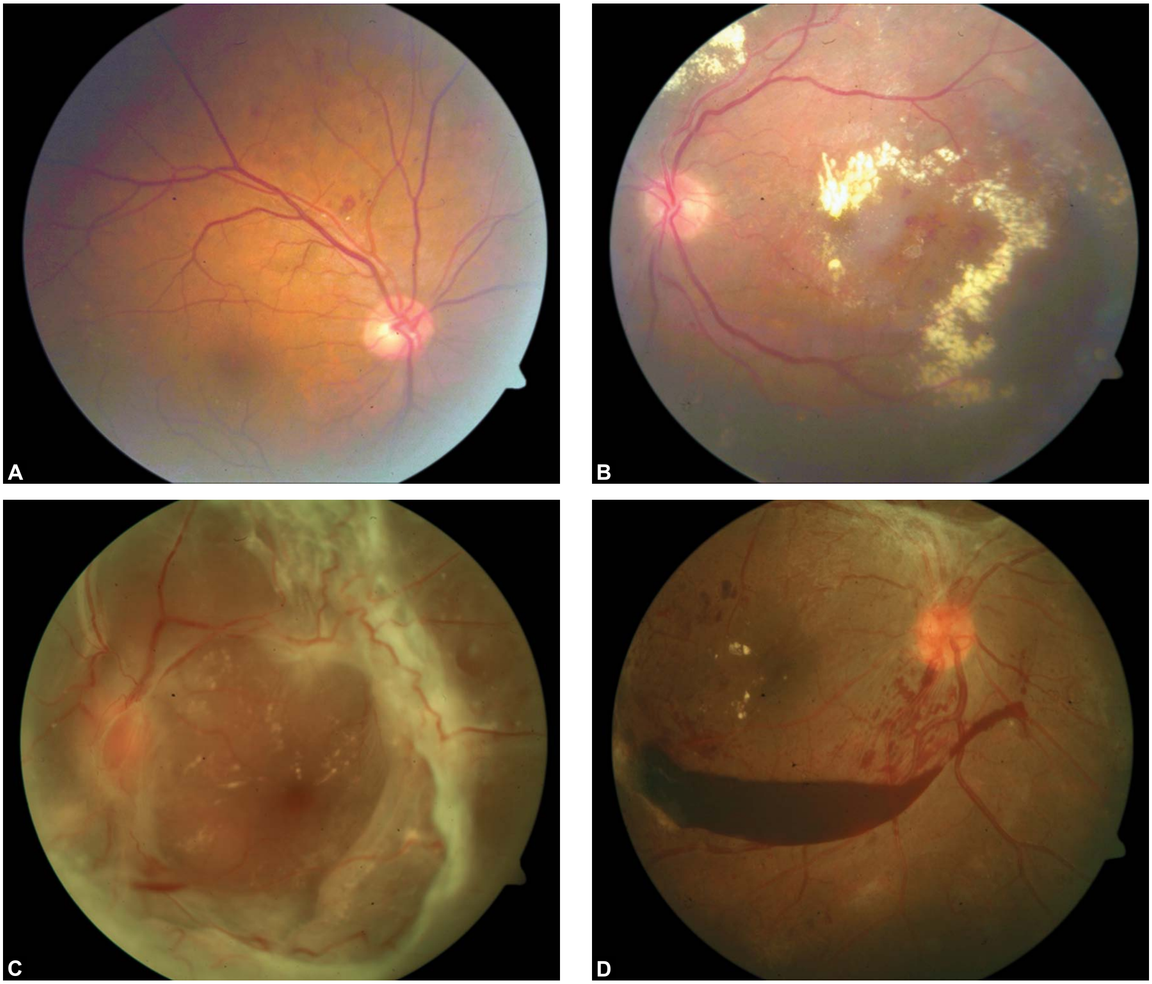

Preretinal
hemorrhage

Fig. 11.18: PDR with preretinal hemorrhage

- Cherry red spot because of the bright red reflex from the intact choroids which shines through the thin foveola in contrast to the surrounding retina which is white because of edema.
- After few weeks optic atrophy sets in and the edema of the retina subsides **(Fig. 11.20)**.

Causes for cherry red spot

Central retinal artery occlusion
Berlin's edema
Niemann pick disease
Sandhof's disease
Tay sach's disease



Figs 11.19A and D: (A) Mild nonproliferative diabetic retinopathy. *Note:* Few microaneurysms, hard exudates and dot-blot, hemorrhages in one quadrant; (B) Moderate nonproliferative diabetic retinopathy with clinically significant macular edema. *Note:* Hard exudates within 500 micron of the fovea and hard exudates, retinal hemorrhages in two quadrants); (C) Proliferative diabetic retinopathy. *Note:* Fibrovascular proliferation; (D) Preretinal hemorrhage (Subhyaloid hemorrhage). *Note:* Boat shaped hemorrhage

BRANCH RETINAL VEIN OCCLUSION

It is more common than central retinal vein occlusion. Superotemporal branch is commonly involved branch of the retinal vein. Rigid arteriosclerotic artery compressing on the retinal vein is the most common cause for retinal vein occlusion.

Fundus Picture Shows

*Dilated and tortuous vein beyond the site of occlusion **(Fig. 11.21)**.*

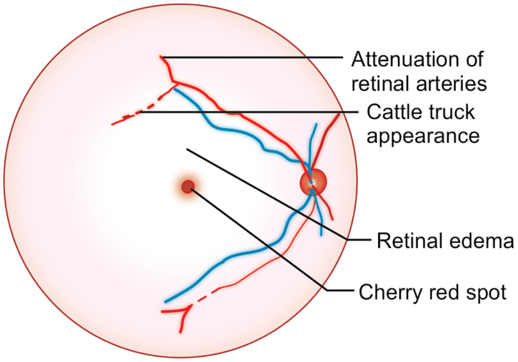


Fig. 11.20: Central retinal artery occlusion. *Note:* Attenuation of retinal arteries, cattle truck appearance, retinal edema, cherry red spot

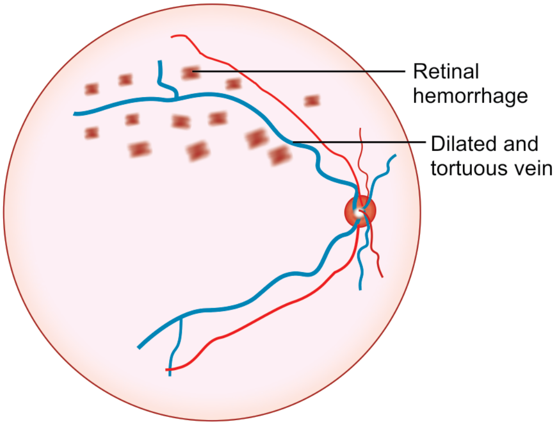


Fig. 11.21: Branch retinal vein occlusion. *Note:* Dilated and tortuous vein in the superotemporal quadrant associated with retinal hemorrhages in the affected quadrant

- Retinal edema and hemorrhages limited to the retina drained by affected retinal vein.

CENTRAL RETINAL VEIN OCCLUSION

It is due to obstruction of the retinal vein at the level of lamina cribrosa. It is the second common retinal vascular disorder second only to diabetic retinopathy. It is of two types.

- Nonischemic central retinal vein occlusion
- Ischemic central retinal vein occlusion **(Figs 11.22A to C)**.

Nonischemic Central Retinal Vein Occlusion

It is common of the two. It is characterized by mild to moderate decreased visual acuity.

Fundus picture shows

- Mild tortuosity and engorgement of retinal veins
- Few retinal hemorrhages **(Fig. 11.23)**.

Ischemic Central Retinal Vein Occlusion

It is characterized by marked decrease in visual acuity, relative afferent papillary defect on the affected side.

Fundus picture shows

- Retinal venous engorgement and tortuosity
- Widespread retinal hemorrhages giving rise to tomato splashed appearance
- Cotton wool spots
- Macular edema
- Optic disk edema **(Fig. 11.24).**

Neovascular glaucoma also called Ninety days glaucoma (as it develops within 3 months) is the most common complication occurring in ischemic central retinal vein occlusion because of neovascularization of iris and angle of the anterior chamber.

RETINITIS PIGMENTOSA

It is a pigmentary dystrophic condition of photoreceptors usually involving the rods more than the cones.

It is one of the common cause of retinal blindness.

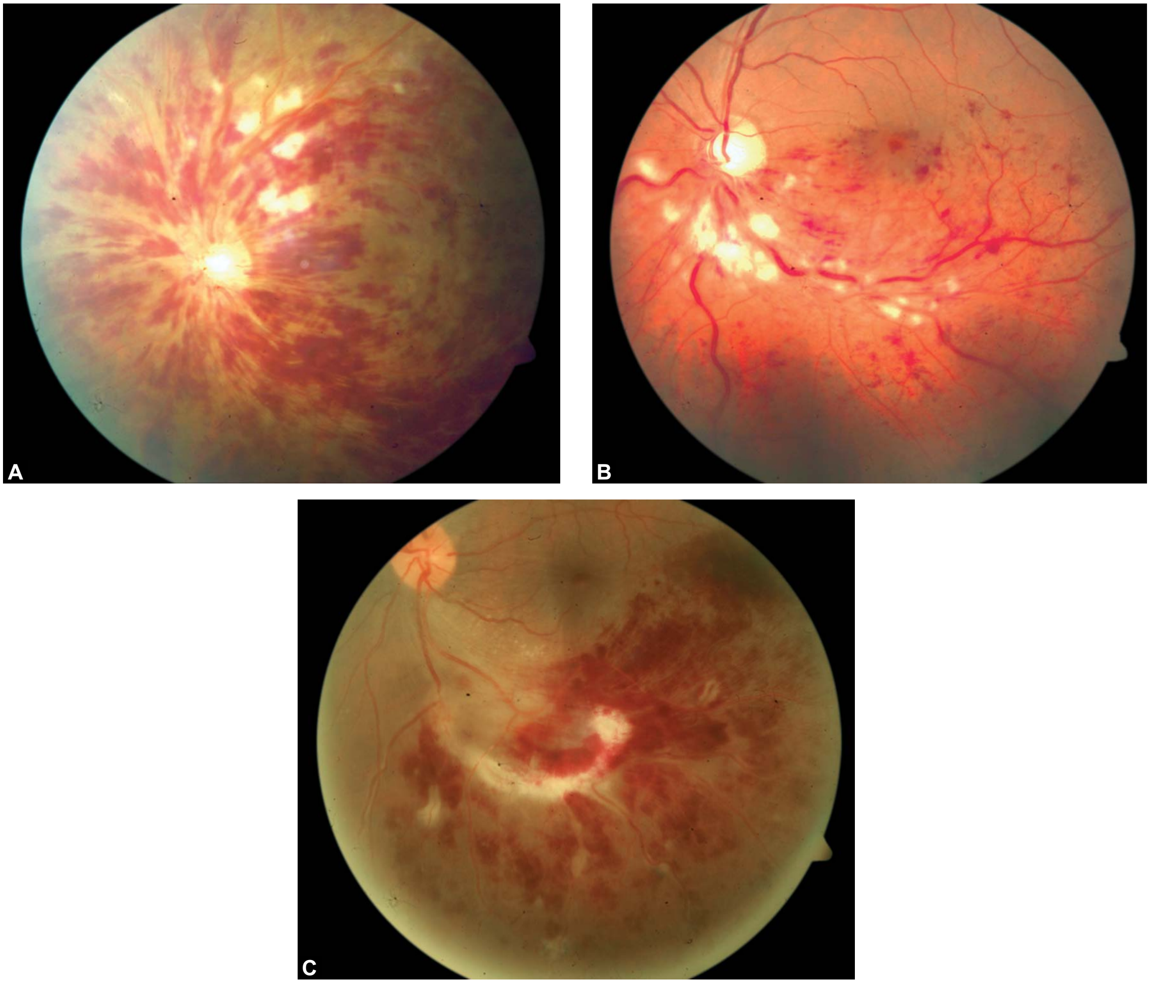
Patient presents with night blindness and delayed dark adaptation **(Figs 11.25A and B)**.

Fundus picture shows

- Attenuation of retinal arteries
- Bony corpuscle retinal pigmentary changes
- Pale waxy optic disk **(Fig. 11.26)**.

Atypical Types of Retinitis pigmentosa

Sector retinitis pigmentosa where one sector of retina is involved.



Figs 11.22A to C: (A) Central retinal vein occlusion. *Note:* Tortuous retinal veins, retinal hemorrhages, cotton wool spots in all the four quadrants and disk edema; (B) Hemi retinal vein occlusion. *Note:* Tortuous retinal veins, retinal hemorrhages and cotton wool spots in two inferior quadrants; (C) Branch retinal vein occlusion. *Note:* Tortuous retinal veins, retinal hemorrhages and cotton wool spots in one quadrant (inferotemporal)

Pericentric retinitis pigmentosa where pigmentary abnormalities are limited to center of the retina.

Retinitis pigmentosa sine pigmento where pigmentary changes are absent.

Retinits punctata albescens where fundus shows white dots instead of black bony corpuscular pigments.

Ocular Associations of Retinitis Pigmentosa

- Posterior subcapsular cataract
- Myopia
- Open angle glaucoma
- Optic disk drusen
- Keratoconus.

Systemic associations of retinitis pigmentosa are Bassen–Kornzweig syndrome characterized by

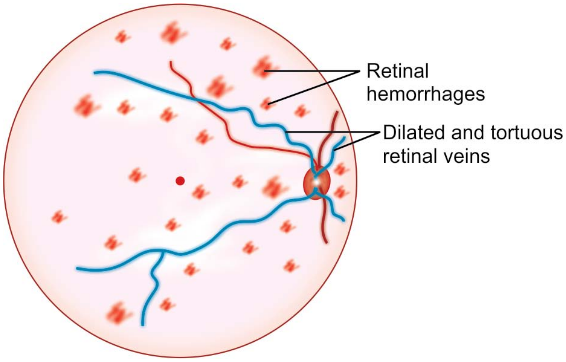

Retinal hemorrhages
Dilated and tortuous retinal veins

Fig. 11.23: Nonischemic central retinal vein occlusion

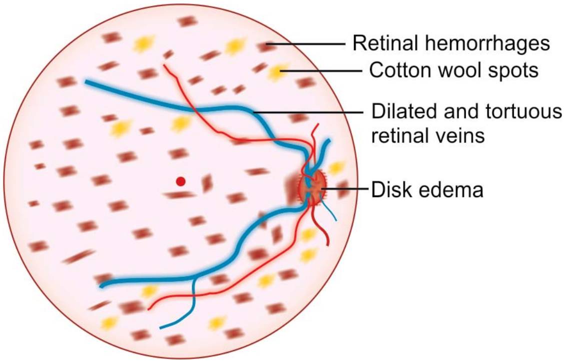
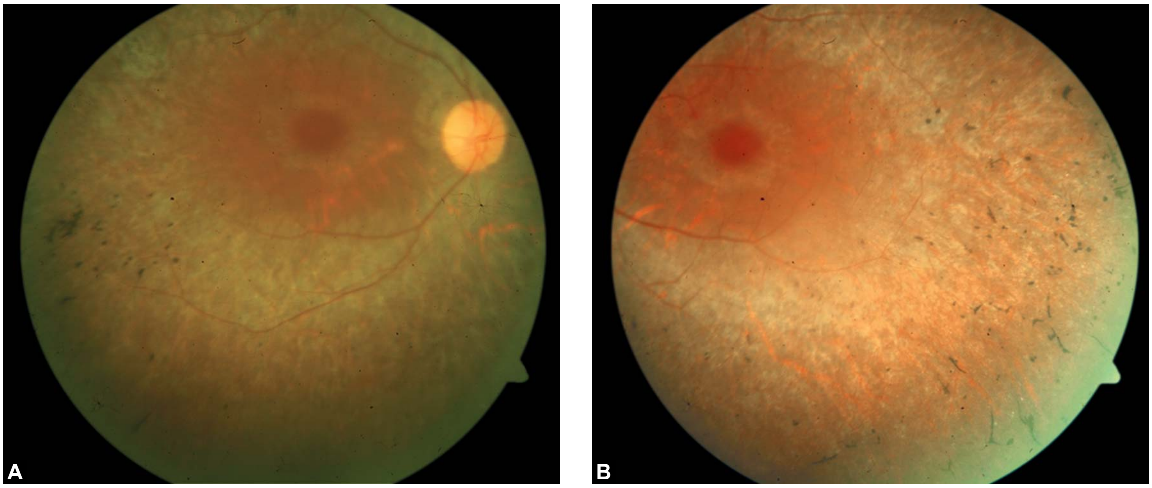

Retinal hemorrhages
Cotton wool spots
Dilated and tortuous retinal veins
Disk edema

Fig. 11.24: Ischemic central retinal vein occlusion



Figs 11.25A and B: Retinitis pigmentosa. *Note:* Attenuation of retinal arteries, waxy disk pallor of optic disk and bony corpuscle pigmentation

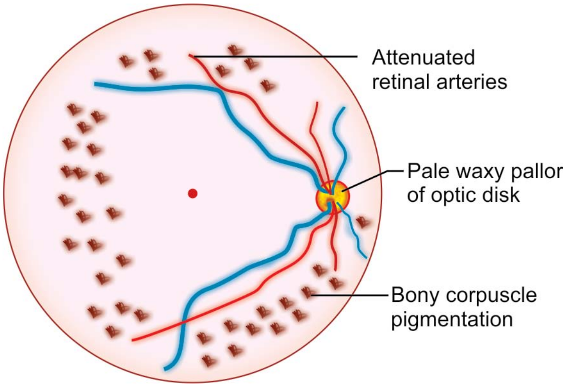

Attenuated retinal arteries
Pale waxy pallor of optic disk
Bony corpuscle pigmentation

Fig. 11.26: Retinitis pigmentosa

abetalipoproteinemia, fat malabsorption, spinocerebellar ataxia and retinitis pigmentosa.

Refsum's syndrome characterized by polyneuropathy, cerebellar ataxia, deafness, anosmia and Retinitis pigmentosa.

Usher's syndrome characterized by deafness and Retinitis pigmentosa.

Laurence-Moon-Biedl-Bardet syndrome characterized by polydactyly, obesity, hypogenitalism, mental retardation and retinitis pigmentosa.

Kearns-Sayre syndrome characterized by chronic progressive external ophthalmoplegia, heart block, mitochondrial myopathy and retinitis pigmentosa.

CENTRAL SEROUS RETINOPATHY

It is a self-limited disease seen in young males with type A personality.

Patient presents with diminision of vision with positive scotoma and metamorphopsia.

Visual acuity will be in the range of 6/9 to 6/12 and refraction showing hypermetropic refraction.

Fundus picture shows

Round or oval detachment of sensory retina at the posterior pole **(Fig. 11.27)**.

Fundus fluorescein angiography shows smoke-stack pattern or Ink blot pattern **(Fig. 11.28)**.

CYSTOID MACULAR EDEMA

It results due to accumulation of fluid in the outer plexiform and inner nuclear layers of the retina in the macula centered aroud the foveola.

It follows a variety of diseases like postoperative complication of cataract surgery, diabetic retinopathy, retinal vein occlusion, retinitis pigmentosa.

Fundus picture shows: Honeycomb appearance **(Fig. 11.29)**.

Fundus fluorescein angiography shows flower petal appearance.

MYOPIA

- Fundus changes occur usually when myopia is more than 6 D and the axial length is more than 25 mm.
- High myopia associated with increased axial length of eyeball and degenerative changes involving sclera, choroids and retina.

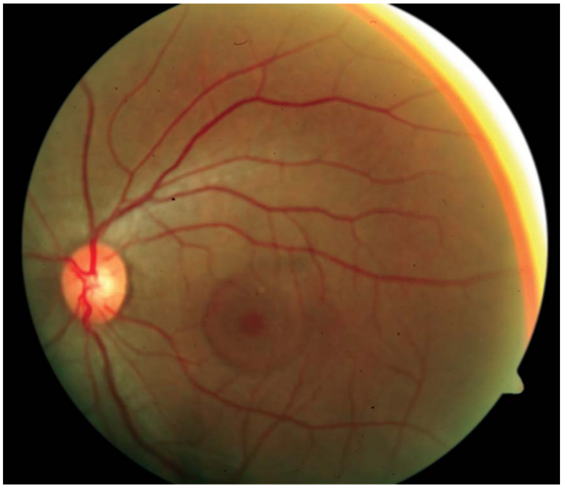


Fig. 11.28: Central serous retinopathy. *Note:* Elevation of macular area demarcated by a circular ring

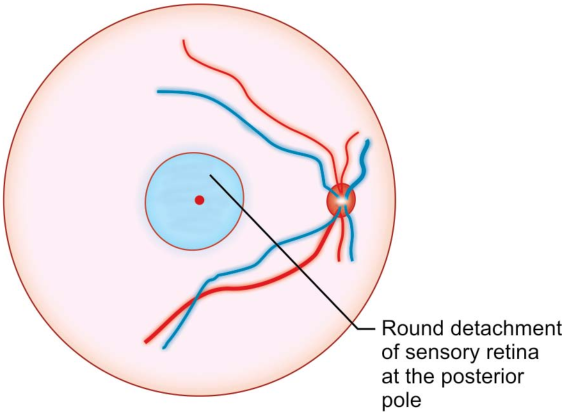


Fig. 11.27: Central serous retinopathy. *Note:* Round detachment of sensory retina at the posterior pole

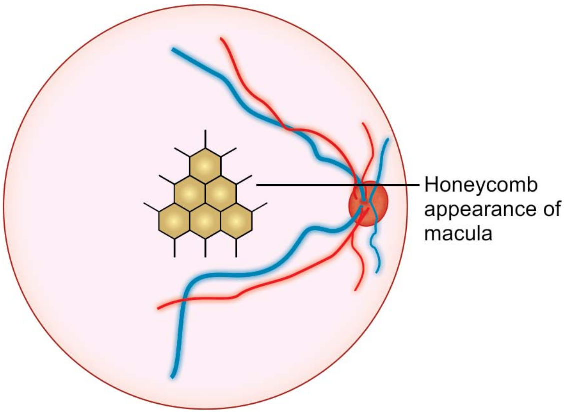


Fig. 11.29: Cystoid macular edema. *Note:* Honeycomb appearance of macula

Fundus changes in high myopia include:

- Tilted optic disk with peripapillary crescent
- Chorioretinal atrophic patches involving posterior pole and macula
- Foster Fuch's spot—circular pigmented lesion developing after macular hemorrhage
- Lacquer cracks—irregular yellow lines representing breaks in Bruch's membrane
- Posterior staphyloma
- Macular hole
- Vitreous degeneration and posterior vitreous detachment
- Periphery of the retina shows retinal degenerations like Lattice degeneration and Snailtrack degeneration **(Fig. 11.30)**.

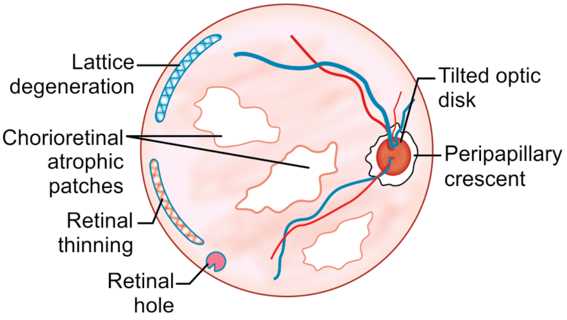


Fig. 11.30: Pathological myopia

Ocular Associations of High Myopia

- Increased incidence of retinal detachment
- Posterior subcapsular cataract
- Increased incidence of open angle glaucoma **(Figs 11.31A to D)**.

Systemic Associations of High Myopia

Marfan's syndrome characterized by cardiac (Mitral valve prolapse, dilatation of aorta), ocular (Subluxation of lens, myopia) and musculoskeletal abnormalities (long extremities, slender, thin, long fingers).

Stickler's syndrome characterized by orofacial abnormalities, high myopia, increased incidence of retinal detachment and arthropathy).

Ehlers-Danlos syndrome characterized by hyper-extensibility of joints, subluxation of lens, high myopia and blue sclera.

PAPILLEDEMA

Bilateral, noninflammatory, passive optic disk edema as a result of raised intracranial pressure is called papilledema **(Fig. 11.32)**.

Fundus picture of established papilledema shows **(Figs 11.33A and B)**:

Vascular Signs

- Hyperemia of optic disk
- Hemorrhages of optic disk and peripapillary hemorrhages
- Edema of optic disk (>1 mm or >3D)
- Hard exudates
- Congestion and tortuosity of peripapillary vessels
- Cotton wool spots.

Mechanical Signs

- Anterior extension of optic nerve head
- Blurring of optic disk margin
- Edema of nerve fiber layer
- Folds of retina
- Filling of the optic cup

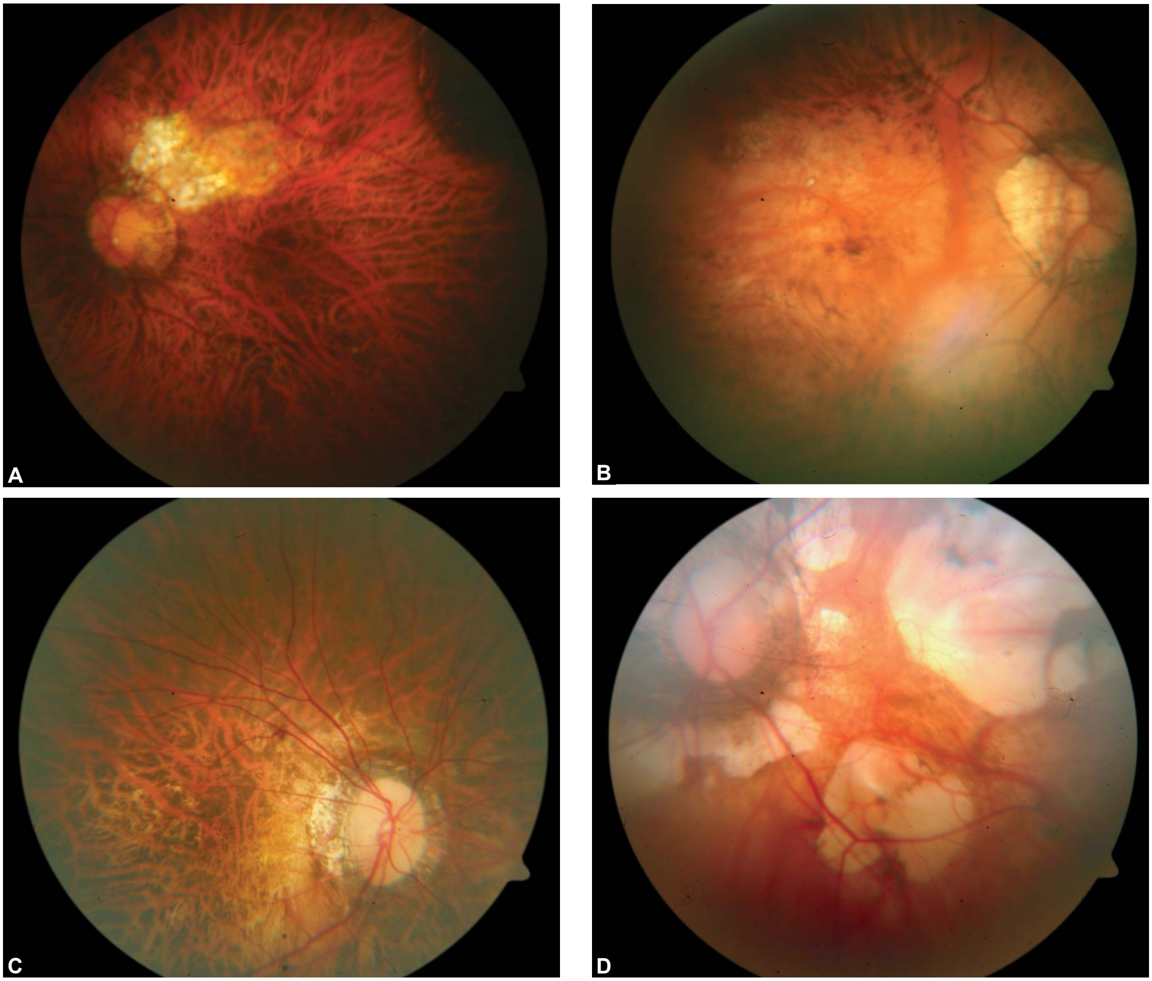
Based on the fundus picture papilledema can be classified as:

- Early papilledema
- Established papilledema
- Chronic papilledema
- Atrophic papilledema.

Early papilledema shows hyperemia, mild elevation of optic disk, blurring of disk margins and loss of spontaneous venous pulsations.

Chronic papilledema shows champagne cork appearance with absence of cotton wool spots and hemorrhages.

Atrophic papilledema shows secondary optic atrophy.



Figs 11.31A to D: Fundus changes in pathological myopia. *Note:* Temporal crescent, tilted disk, chorioretinal atrophic patches, Foster Fuch's spot

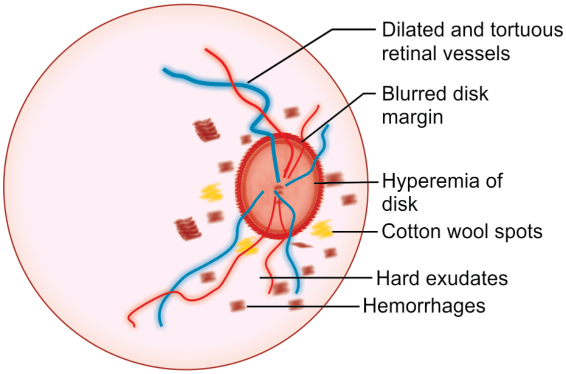

Dilated and tortuous retinal vessels
Blurred disk margin
Hyperemia of disk
Cotton wool spots
Hard exudates
Hemorrhages

Fig. 11.32: Papilledema

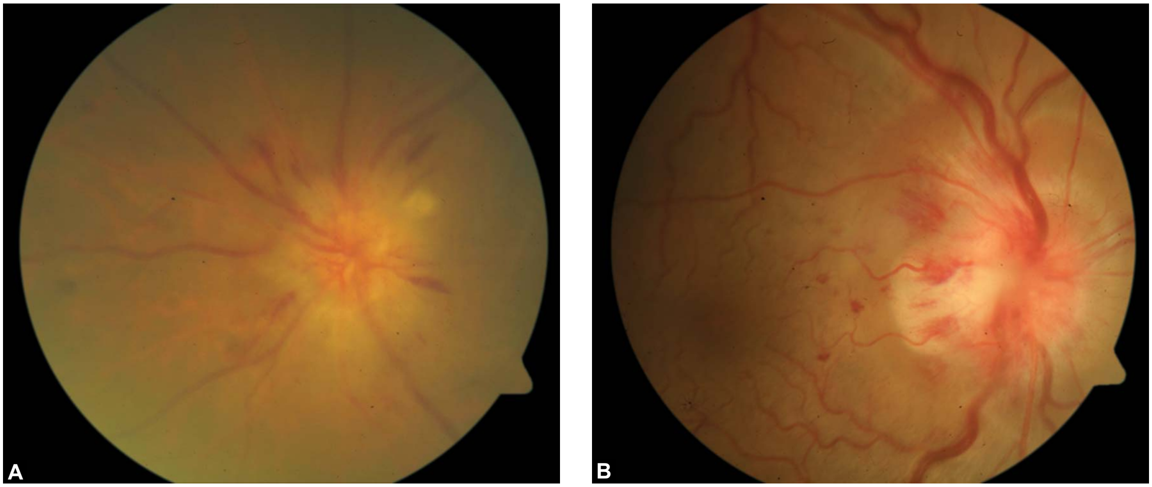
OPTIC NEURITIS

Inflammation of optic nerve is called optic neuritis.

Based on the ophthalmoscopic features it can be classified as:

- Papillitis
- Retrobulbar neuritis
- Neuroretinitis.

Papillitis shows hyperemia of optic disk, edema of optic disk < 1 mm, peripapillary hemorrhages. It has features similar to papilledema, differentiated from papilledema



Figs 11.33A and B: Papilledema. *Note:* **Vascular signs**—Hyperemia, edema (>1 mm), hard exudates, congestion, cotton wool spots, hemorrhages; **Mechanical signs**—Anterior extension of optic nerve head, blurring of optic disk margin, edema of nerve fiber layer, folds of retina, filling of the optic cup

by marked visual loss (in papilledema vision is affected in late stag due to optic atrophy) disk edema <1 mm or 3D, less venous engorgement, less retinal hemorrhages, presence of posterior vitreous haze because of cells in posterior vitreous and it is usually unilateral **(Fig. 11.34)**.

Retrobulbar neuritis shows normal optic disk. Patient presents with marked diminision of vision, relative afferent pupillary pathway defect. It is described as a disease where neither ophthalmologist sees anything nor patient sees anything.

Neuroretinitis shows features of papillitis plus macular star because of hard exudates.

Neuroretinitis is most frequently due to viral infections **(Figs 11.35A and B)**.

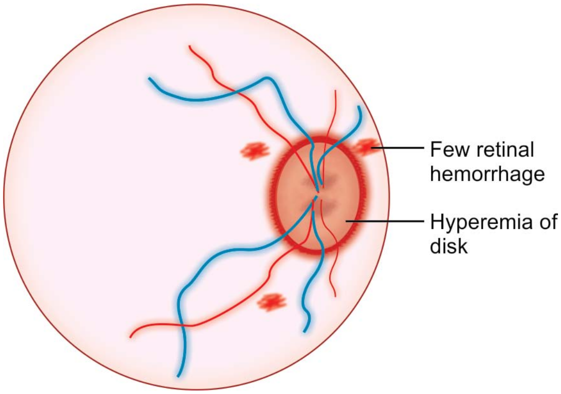


Fig. 11.34: Papillitis

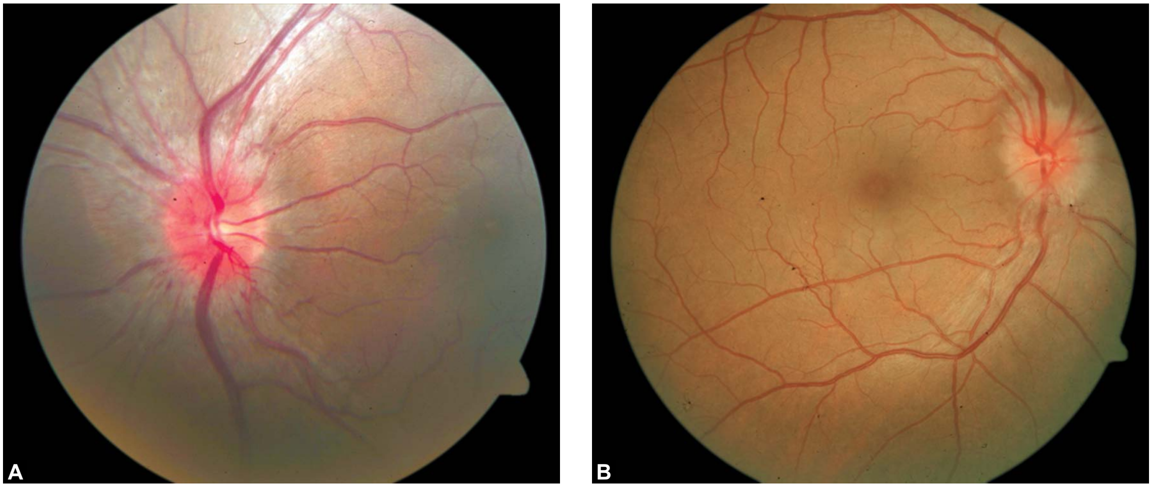
OPTIC DISK CHANGES IN GLAUCOMA

Early Glaucomatous Changes

- Atrophy of retinal nerve fiber layer seen with red free light
- Vertically oval cup as a result of selective loss of neuroretinal rim in inferior and superior poles (ISNT rule-normally neuroretinal rim is widest in inferior region followed by superior, nasal and temporal regions)
- Large size of the optic cup >0.6
- Splinter hemorrhages of optic disk **(Fig. 11.36)**.

Advanced Glaucomatous Changes

- Nasal shift of retinal vessels
- Bayoneting sign—vessels appearing broken off at the margin



Figs 11.35A and B: Optic neuritis (Papillitis). *Note:* Optic disk shows hyperemia, edema (<1 mm) blurring of disk margins, obliteration of physiological cup and tortuous retinal veins

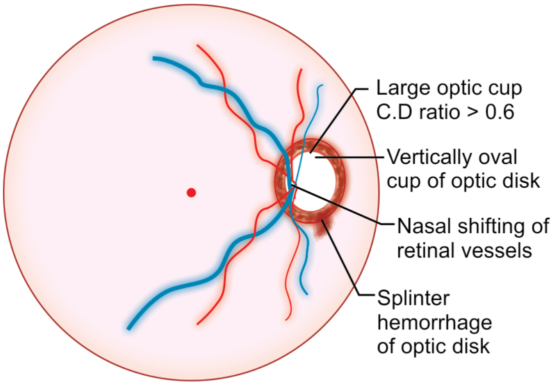

Large optic cup
C.D ratio > 0.6
Vertically oval
cup of optic disk
Nasal shifting of
retinal vessels
Splinter
hemorrhage
of optic disk

Fig. 11.36: Optic disk changes in glaucoma. *Note:* Vertically oval cup of optic disk, nasal shift of retinal vessels, bayonetting, spliner hemorrhage of optic disk

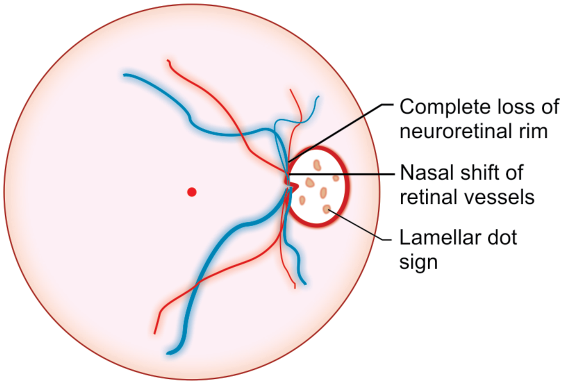
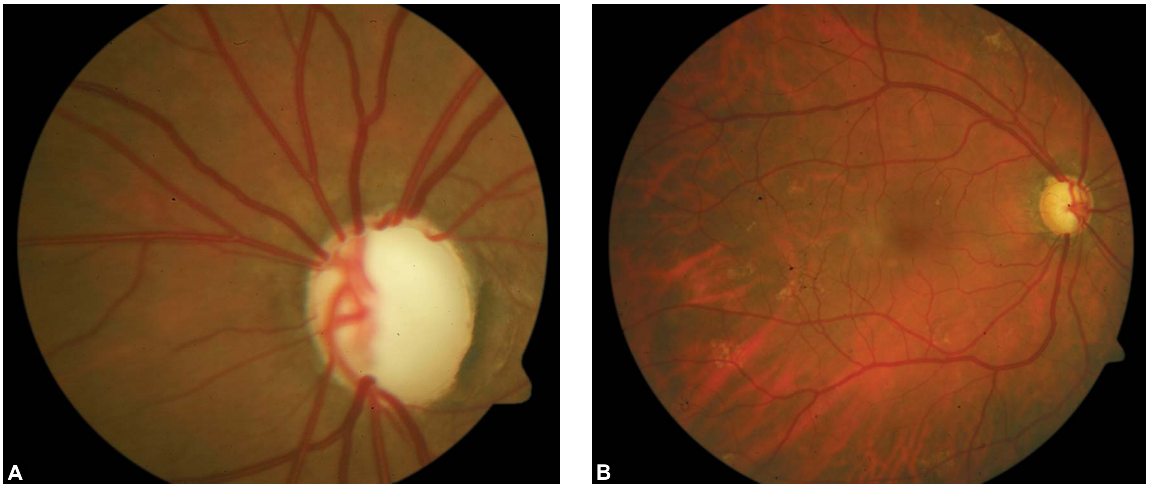

Complete loss of
neuroretinal rim
Nasal shift of
retinal vessels
Lamellar dot
sign

Fig. 11.37: Glaucomatous optic atrophy. *Note:* Nasal shift of retinal vessels, lamellar dot sign, complete loss of neuroretinal rim

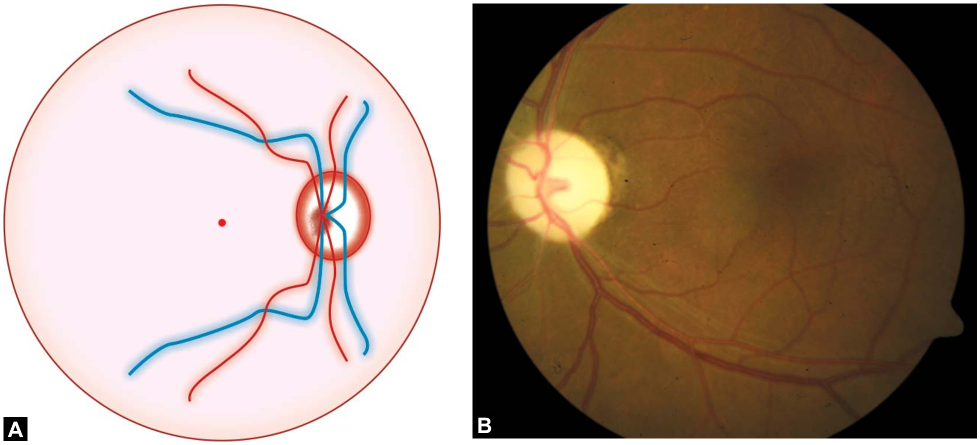
- Marked cup size of optic cup 0.7 to 0.9
- Thinning of neuroretinal rim
- Lamellar dot sign—visualization of pores in the lamina cribrosa
- Optic atrophy is the end result of glaucoma. Glaucomatous optic atrophy shows deep cup with nasalization of retinal vessels **(Figs 11.37 and 11.38A and B)**.

PRIMARY OPTIC ATROPHY

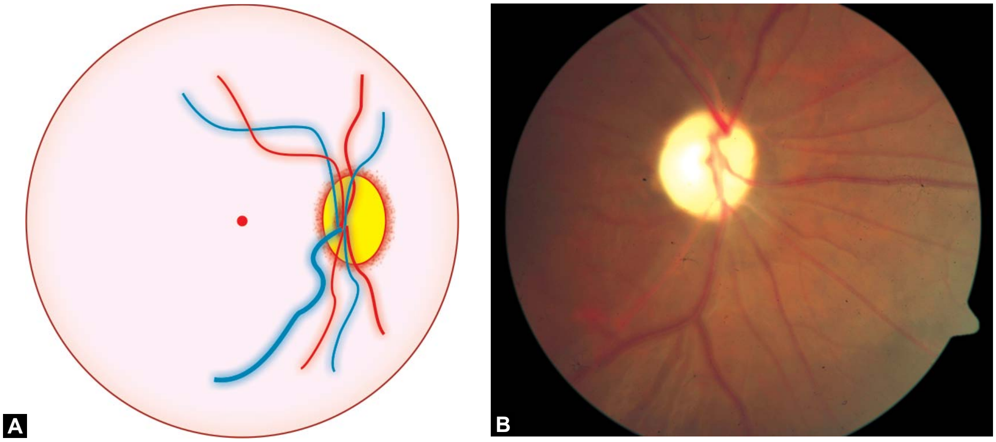
It occurs without antecedent swelling of optic disk.



Figs 11.38A and B: Glaucomatous optic disk changes. *Note:* Marked cupping of optic disk, Bayonetting sign (vessels appear of being, broken of at the margin), thinning of neuroretinal rim



Figs 11.39A and B: (A) Primary optic atrophy. *Note:* Pale optic disk with clear delineated disk margins; (B) Primary optic atrophy. *Note:* Pale white color of the optic disk, clear margins of the optic disk and normal surrounding retina. **Common causes:** Intracranial tumors pressing on the anterior visual pathway, multiple sclerosis



Figs 11.40 A and B: (A) Secondary optic atrophy. *Note:* Dirty white optic disk with poorly delineated disk margins **(Fig. 11.41)**; (B) Secondary optic atrophy. *Note:* Dirty white color of the optic disk, blurred disk margins and perivascular sheathing of surrounding retinal vessels. **Common causes:** Papilledema and papillitis

The causes of primary optic atrophy include tumors compressing optic nerve, retrobulbar optic neuritis, hereditary optic neuropathy…

Fundus Picture Shows

Pale optic disk with clear delineated disk margins

- Kestenbaum sign-reduction in the number of small blood vessels on the optic disk
- Normal retinal vessels and surrounding retina **(Fig. 11.39A and B)**.

SECONDARY OPTIC ATROPHY

It occurs with antecedent swelling of the optic disk **(Figs 11.40A and B)**.

The causes include papilledema, papillitis, anterior ischemic optic neuropathy.

Fundus picture shows

- Dirty white optic disk with poorly delineated margins of the optic disk due to excessive gliosis
- Attenuation of retinal vessels and perivascular sheathing.

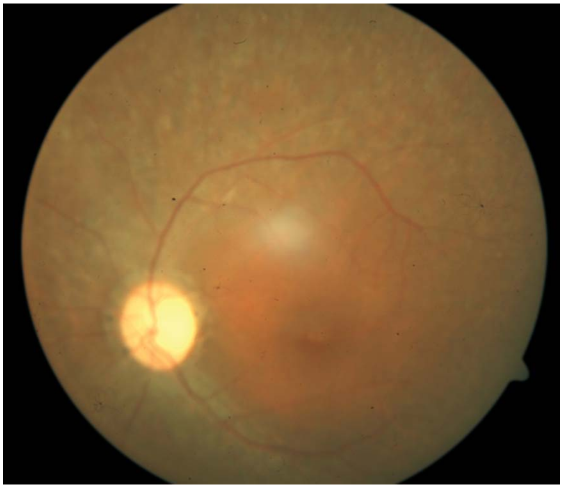


Fig. 11.41: Consecutive optic atrophy. *Note:* Yellow waxy pallor of the optic disk and attenuation of the surrounding retinal vessels. **Common causes:** Retinitis pigmentosa

CONSECUTIVE OPTIC ATROPHY

It occurs due to degenerative/ inflammatory/ vascular lesions of surrounding retina.

The causes include central retinal artery occlusion, central retinal vein occlusion, retinitis pigmentosa, pathological myopia…..

Fundus Picture Shows

Yellow waxy optic disk

- Surrounding retina shows the causative disease, e.g. Retinitis pigmentosa **(Fig. 11.41)**.

IMPORTANT DATES IN OPHTHALMOLOGY

World Sight Day: Second Thursday of October every year is marked as World Sight Day to draw attention on blindness and its implications.

World Glaucoma Day: March 12th of every year is observed as Glaucoma Day to spread awareness regarding glaucoma which is called as silent thief of vision.

World Glaucoma Week: To maximize the awareness regarding glaucoma day is replaced by glaucoma week. It is observed between March 11 to 17 of every year.

National Eye Donation Fortnight: It is celebrated between August 25 to September 8 to encourage and to create awareness for eye donation.

National Eye Donation Day: September 8th of every year.

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